DOES THE ARMY COMMAND AND GENERAL STAFF COLLEGE STUDENT RECEIVE AN APPROPRIATE LEVEL OF SPACE-RELATED CURRICULUM?

A thesis presented to the Faculty of the U.S. Army
Command and General Staff College in partial
fulfillment of the requirements for the
degree

MASTER OF MILITARY ART AND SCIENCE

by

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This study investigates how well CGSC incorporates space into its curriculum. With the advent of DESERT STORM, space technology has emerged as an important force multiplier. This study examines whether CGSC has ensured that students receive an appropriate level of space-related curriculum. A formative evaluation of the space curriculum was conducted. This seven phased research began with a review of space curriculum at CGSC and the other ISSs. The next three phases were questionnaires to evaluate student's knowledge of space systems/products, for department review of their core and elective courses, and to key Space Command commanders. The most important questionnaire evaluated graduates as to what space knowledge did they require in their duty position. The study concludes that CGSC students do not need to know an exhaustive amount of space knowledge. Students need to understand how force enhancement systems, (communication, navigation, weather and intelligence products) can contribute to the success of their mission. CGSC space curriculum should focus on the critical space systems/products and how to access them. Integration of space into the core and elective courses and the development of a comprehensive reference document will ensure a graduate comprehends key space systems/products and how to access them.

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Accepted this 7th day of June 1996 by:

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The opinions and conclusions expressed herein are those of the student author and do not necessarily represent the views of the U.S. Army Command and General Staff College or any other governmental agency. (References to this study should include the foregoing statement.)

ABSTRACT

DOES THE ARMY COMMAND AND GENERAL STAFF COLLEGE STUDENT RECEIVE AN APPROPRIATE LEVEL OF SPACE-RELATED CURRICULUM by Lt Col William P. Huben, USAF, 85 pages.

This study investigates how well CGSC incorporates space into its curriculum. With the advent of DESERT STORM, space technology has emerged as an important force multiplier. This study examines whether CGSC has ensured that students receive an appropriate level of space-related curriculum.

A formative evaluation of the space curriculum was conducted. This seven phased research began with a review of space curriculum at CGSC and the other Intermediate Service Schools (ISS). The next three phases were questionnaires to evaluate student's knowledge of space systems/products, for department review of their core and elective courses, and to key Space Command commanders. The most important questionnaire evaluated graduates as to what space knowledge did they require in their duty position.

The study concludes that CGSC students do not need to know an exhaustive amount of space knowledge. Very few officers will be involved with space launches, control of space assets or development of space systems. Students need to understand how force enhancement systems, (communication, navigation, weather and intelligence products) can contribute to the success of their mission. CGSC space curriculum should focus on the critical space systems/products and how to access them. The three hour core course is a sufficient introduction but space curriculum must be integrated throughout the 524 core hours and into all departments via the 2500 hours of electives. Integration of space into the core and elective courses and the development of a comprehensive reference document will ensure a graduate comprehends key space systems/products and how to access them.

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I would like to recognize and thank the following individuals who's insights and extensive expertise contributed significantly to this thesis and the completion of the MMAS curriculum.

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I would like to sincerely thank my Chairman, Lieutenant Colonel Benjamin Tyler who lead the committee throughout this lengthy process. His conduct of the MMAS process, comprehensive exam, thesis defense, and inputs all made the MMAS program run smoothly.

With Mr. Ed Burns being transferred to Fort Monroe and subsequently retiring I would like to thank him for his insights when he was part of the committee. With Mr. Burns departure Major Daniel Moorer replaced him as the second reader. Major Moorer's outstanding knowledge of space systems and space operations was evident with his insightful contributions. With short notice he stepped in and made some strong technical inputs. With Major Moorer's retirement Major Henry P. Rivest took over the second reader responsibilities and I thank him for his insights and contributions.

Important contributions to this thesis were provided by Lieutenant General Donald M. Lionetti, Commander, U.S. Army Space and Strategic Defense Command. His insightful

comments on the future role of the U.S. Army in Space and his inputs on what he believes CGSC graduates require helped shape the space curriculum requirements. Also Colonel Kulbacki of Army Space Command provided a clear, concise perspective on space training for CGSC graduates. These superb officers provided experience and insights, and their willingness to contribute to this research project was significant.

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

LIST OF ABBREVIATIONS

ABM	Anti-Ballistic Missile
AFSATCOM	Air Force Satellite Communications System
AFSC	Armed Forces Staff College
AFSPACECOM	Air Force Space Command
ARSPACE	Army Space Command
ASAT	Anti-Satellite
ASI	Army Space Institute
ASPO	Army Space Program Office
ASTRO	Army Space Technical Research Office
BMD	Ballistic Missile Defense
C3I	Command, Control, Communications and Intelligence
CINC	Commander of a Unified Combat Command
CSOC	Consolidated Space Operations Center
DMSP	Defense Meteorological Satellite Program
DSCS	Defense Satellite Communications System
DSP	Defense Support Program
EHF	Extremely High Frequency
ELINT	Electronic Intelligence
EORSAT	ELINT Ocean Reconnaissance Satellite
EOSAT	Earth Observation Satellite Company

ESA	European Space Agency
ETUT	Enhanced Tactical User's Terminal
FLTSATCOM	Fleet Satellite Communications System
GBR	Ground-Based Radar
GEO	Geosynchronous Earth Orbit
GLONASS	Global Navigation Satellite System
GMFSC	Ground Mobile Forces Satellite Communications
GOES	Geostationary Operational Environmental Satellite
GPS	Global Positioning System
GSTS	Ground-Based Surveillance and Tracking System
INTELSAT	International Telecommunications Satellite Organization
IONDS	Integrated Operations Nuclear Detonation Detection System
JCSOS	Joint and Combined Staff Officer School
JPME	Joint Professional Military Education
JSTARS	Joint Surveillance Target Attack Radar System
JTIDS	Joint Tactical Information Distribution System
LEASAT	Leased Satellite
LEO	Low Earth Orbit
LIGHTSAT	Lightweight Satellite
MEPD	Military Education Policy Document
MILSATCOM	Military Satellite Communications
MILSTAR	Military Strategic Tactical and Relay Satellite
MMIS	Military Man in Space
MSI	Multi-Spectral Imagery

NASA	National Aeronautics and Space Administration
NASP	National Aerospace Plane
NAVSPACECOM	Naval Space Command
NAVSTAR	Navigation System Timing and Ranging
NOAA	National Oceanic and Atmospheric Administration
NORAD	North American Aerospace Defense Command
NUDETS	Nuclear Detection System
PALS	Protection Against Accidental Launch System
PJE	Program for Joint Education
PLGR	Precision Lightweight GPS Receiver
PME	Professional Military Education
RORSAT	Radar Ocean Reconnaissance Satellite
RSTA	Reconnaissance, Surveillance, and Target Acquisition
SBI	Space-Based Interceptor
SDC	Strategic Defense
SDI	Strategic Defense Initiative
SDIO	Strategic Defense Initiative Organization
SDS	Space Defense System; also Satellite Data System
SHF	Super High Frequency
SLGR	Small Lightweight GPS Receiver
SPOT	Satellite Pour l'Observation de la Terre
SSLV	Standard Small Launch Vehicle
SSTS	Space-Based Surveillance and Tracking System
STS	Space Transportation System

TACSAT	Tactical Satellite
TDRSS	Tracking and Data Relay Satellite System
TENCAP	Tactical Exploitation of National Capabilities
TIROS	Television and Infrared Observation Satellite
TMD	Theater Missile Defense
TPIO-SPACE	TRADOC Program Integration Office for Space
UFO	UHF Follow-on
UHF	Ultrahigh Frequency
USSPACECOM	United States Space Command
WWMCCS	World Wide Command and Control System

CHAPTER 1

INTRODUCTION

At the U.S. Army Command and General Staff College (CGSC), Fort Leavenworth, Kansas, a selected group of Army, Navy, Air Force, Marine Corps, and international officers attend the intermediate service school. These officers are educated in "the values and attitudes of the profession of arms and in the conduct of military operations during peace, conflict, and war with emphasis at corps and division levels."[1]

The Army needs to ensure that it provides its commanders with the best possible trained and informed CGSC graduates. The use of space is one area these graduates must be able to understand in order to plan better and to conduct warfighting operations. The basis for my formative evaluation is a core lesson taught at CGSC. It is a three-hour lesson taught to 1280 students on the Army's use of space systems (satellites): its purpose is to improve and increase their warfighting capability. I evaluated this in-residence lesson to determine if it was adequate and appropriate for the needs of Army commanders.

There is a higher order of goals and objectives which I addressed to determine if three hours of space instruction is appropriate to meet the intended outcome.

The goals of CGSC are to develop officers who display tactical and technical combined arms proficiency; understand joint and combined operations; and can prepare, fight, and sustain forces across the spectrum of conflict.[2]

For the core course, Joint and Combined Environments, the purpose of three hours of study in the military applications of space is to understand the contributions that military space systems make to deterrence and to warfighting capabilities.[3]

The lesson focuses on two learning objectives. The first objective is to describe the U.S. space assets for national security. The standard used to determine if the student has met this objective requires the student to describe basic definitions and concepts; the general nature and functions of support systems available to an operational commander; mission capabilities and limitations of space systems; and strategic and operational requirements for space assets. The second learning objective is to describe how U.S. security space assets support a U.S. military commander. The standard for this objective requires the student to describe the following items: how a commander accesses space systems, each system's command and control features, and problems and solutions associated with the use of space assets in support of joint and combined operations.[4]

The Joint Professional Military Education Phase I (JPME Ph I) objectives below must be addressed in the core course.

1. Know how the roles and missions, capabilities, and limitations of U.S. military forces affect joint and combined operations.

2. Know how the U.S. national intelligence organizations and Command, Control and Communications (C3) support U.S. military commands during joint and combined operations.

3. Know major C3 and intelligence issues and problems that face commanders and staff officers in planning and conducting joint and combined operations.[5]

My goal for this evaluation was to determine whether or not these stated goals and objectives have actually been met in the three-hour lesson.

Significance of Study

For the last forty-five years, the Army has been struggling to identify an appropriate role for itself in space. As a leading member at the start of missile development, the Army's role has faded over time until its recent resurgence. With the advent of Desert Storm, space technology has emerged as an important force multiplier. This resurgence has been highlighted by such individuals as the former Chairman, Joint Chiefs of Staff, General Colin Powell, who on 14 December 1990 stated: "For communications and command, for intelligence and navigation, we need to be in space, and we need a variety of space systems."[6] Other military leaders also praised the U.S. space effort in Desert Storm. The inclusion of space as the 4th dimension in the Joint Professional Military Education Program demonstrates the increased emphasis on space operations. However, has CGSC made any effort to ensure that field grade officer-students receive an appropriate level of space-related curriculum?

Research Questions

My primary research question is stated as follows:

Does CGSC devote time, resources, and personnel to teach students an appropriate level of space-related curriculum?

My secondary research questions are as follows:

1. What is the appropriate level of space-related curriculum?

2. What level of space curriculum is being taught at the Air, Navy, and Marine Corps Command and Staff Colleges and are these levels appropriate?

3. What is the level of space knowledge with which the Army Commander expects his staff officers to be familiar?

Assumptions

The following assumptions formed a foundation for this study.

1. An analysis of the difference between the level of space-related knowledge desired and that of new service school students determines the appropriate level of time, resources, and personnel that the Army needs to devote to space instruction.

2. The impact of space technology on military doctrine and strategy will not increase in the future.

Definitions

A listing of key terms is located in the Glossary. All terms come from Joint Chiefs of Staff Publication 0-1 unless cited differently.

Limitations

1. In producing an unclassified thesis, I did not probe into any Technical Exploitation of National Capabilities (TENCAP) material or into any of the classified intelligence systems.

2. The minimal data received from the Navy and the lack of data received from the Marine Corps limits the scope of the research.

3. The Commanders whom I surveyed may not have a firm grasp of what a CGSC graduate should know about space operations.

Delimitations

1. A major delimitation that I imposed on the thesis is the use of only a limited number of years to analyze the space curriculum at CGSC.

2. There was some discussion about the possible additional space emphasis given to other areas in the curriculum. I did not include them in this study because none of them are currently in

the curriculum. This discussion is a result of senior Army leaders believing space will play an important role in future operations. No study has been done by anyone concerning this leadership concern and so they are responding out of necessity rather than from a firm foundation of described need. Since I do not know in what detail, depth, or at what time interval these changes will be implemented, I am not including them in this thesis.

CHAPTER 2

LITERATURE REVIEW

The publicity created by U.S. use of space assets in DESERT STORM generated a considerable amount of literature for research. In addition to materials from the other intermediate service schools' curriculum, there is ample literature available for research: books, magazine articles, research papers, field manuals, and joint publications. These materials describe the doctrine and assets available for space operations, training, and education. The literature review provides basic information about the civil and military organizations which comprise the U.S. space program and the goals and responsibilities of these organizations.

The review provided basic information about the Army's past role in space as well as the Army's present role in incorporating space throughout its warfighting doctrine. I also reviewed data on the use of space assets in executing AirLand Battle doctrine.

Articles for Review

The following books, studies, and articles were reviewed to develop a background on the Army's role in space and how the Army was organized to develop space programs and doctrine.

Arthur Downey's The Emerging Role of the U.S. Army in Space reviews the U.S. Army's historic involvement with the space program. This involvement dates back to the early 1950s and details the military aspects of that program. He recommends a more active

involvement by the Army in the use of space systems. He recommends training personnel in space capabilities, continuing research and development, and updating doctrine to include space capabilities.

The thesis How Space - The Fourth Operation Medium - Supports Operational Maneuver by Frank P. Janeck examined today's space doctrine and space operations, and how they support the U.S. Army's concept of operational maneuver. Janeck examined space support systems available today as well as proposed systems to see how they can be integrated into operational maneuver. His work resulted in several recommendations to help integrate space support and operational maneuver into a smooth flowing process.

The Army recognized the need to continue to explore and expand its capabilities in space to support Army missions. Daniel Kirby's The Army in Space: An Assessment of Today for Tomorrow investigated the use of space capabilities to enhance and ensure accomplishment of the strategic, operational, and tactical missions. He constructs a model of what the Army's space exploration program should be and then compares it with the actual Army Space Policy program. His work resulted in a number of recommendations to implement a better Army Space Policy in today's environment.

Space Operations doctrine, principles of war, and whether currently accepted principles apply to military space operations were researched in Developing a Foundation for Space Doctrine: Do All the Principles of War Apply to Military Space Operations. Author Jim Mueller used the Air Force principles of war to conduct this research. The author concludes that the military does not have space warfare experience that can be used to develop warfighting doctrine. He recommends using the current principles of war as a foundation for developing doctrine for military space operations.

The report Tactical Application of Space Systems looks at the benefits of space systems to military operations from an international viewpoint, specifically the North American Treaty Organization (NATO). This symposium focused on the attributes of space systems which contribute to the effectiveness of military operations. All the different space systems were discussed and assessed in relation to their capabilities to satisfy military requirements.

John Prall's study looked at the benefits that space systems provide the military. Space and the AirLand Battle looked at the different systems and capabilities that the Army uses to support its warfighting doctrine. This study also makes an assessment of the Army's space infrastructure and the Army's effectiveness in integrating space into its day-to-day operations. Prall's recommendation is that the Army be a tactical and operational user of space services and train and prepare for that role.

The thesis Military Operations on the Surface of an Extraterrestrial Body investigated the conduct of military operations on the surface of an extraterrestrial body. Richard L. Reynard's study examined the possible environment where operations would take place, resources available, and the integration of military doctrine to apply to a military force on an extraterrestrial body. Operational concepts, forces required, and planning for such a situation were also addresses. Reynard concluded that this is new ground for the Army and a lot more work has to be done to meet the requirements of this mission and environment.

The report U.S. Army Space Force Development Assessment by the BDM Corporation provides an assessment of those officers' positions within the Army which should be identified as needing space skills. These officers fill positions in the Army which require specific knowledge of space-related activities to function effectively. The recommendation from BDM is that there are more positions that require space knowledge which are being overlooked by the Army and need to be reconsidered.

The study Analysis of Company Grade Officers' Critical Tasks and Space Capabilities Awareness by the U.S. Army Space Institute examines company grade officer Critical Task Lists, within selected branches, to determine if knowledge of space systems and their capabilities can improve an officer's ability to accomplish his job. A survey was provided to officers to determine their knowledge of space capabilities and to see if shortfalls exist. The study recommended that space system application be integrated into the classroom as part of a common core instruction.

John R. Wood's thesis addresses the reawakening of the Army's interest in space exploration and development. This study The Army and Space: Historical Perspective on Future Prospects is mostly historical, exploring the Army's early role in space as well as comparing its early development with the current resurgence in space operations. Wood finds some applicable lessons which may help Army leaders as they reenter the space arena today and contribute to a new Army space doctrine.

CHAPTER 3

THE HISTORY OF U.S. ARMY'S INVOLVEMENT IN SPACE

The U.S. Army became involved in the space program during World War II and was instrumental in contributing to space exploration programs as the U.S. entered the Cold War era. This portion of my research focused on a historical review into the background and personnel involved with the development of the Army space program from World War II to the present.

Development of Space Capability

> On the morning of 28 May 1940, Robert H. Goddard, the American rocket pioneer, met in Washington D.C. with representatives of the Army Air Corps, Army Ordnance, and the Navy. Goddard briefed the military representatives on work he was doing at his rocket site in New Mexico and offered to develop rockets to meet future defense needs. The military politely turned him down, stating that manned aircraft could deliver more explosives, more accurately, than any foreseeable unmanned rocket.[1]

This short-sightedness by the U.S. Army was short-lived as the Germans used rockets to strike England. As a result of these attacks, Dr. Goddard and his associates began, in the fall of 1941, limited rocket development under contract from the U.S. Army Air Corps. This work on rocket development continued during World War II. The pace increased when the California Institute of Technology received a contract for research and development of long-range rockets from the U.S. Army Ordnance Branch in June 1944. The Army had established the Ordnance Rocket Branch in 1943 to centrally manage rocket development. The California Institute of Technology's Jet Propulsion Laboratory concentrated on studying rocket propulsion and development of long-range surface-to-surface rockets. This project, called Project ORDCIT,

developed and tested 24 solid propellant rockets at Fort Irwin, California. Under this project the Army developed three rockets: the Private, the Corporal, and the Bumper. Due to the late start during WW II, these systems never reached operational testing. As a result of Dr. Goddard's work, the Army also established White Sands Proving Grounds, New Mexico, just north of Fort Bliss, Texas. This site provided the Army with a place to conduct their long-range testing.

As the Army continued to research and develop rockets the Army Air Force was also trying to find its role under the Department of War. The Deputy Chief of Staff of the Army, Lieutenant General Joseph T. McNarney tried to delineate the different developmental responsibilities for these missiles. On 2 October 1944, General McNarney issued a memorandum directing,

1. That the Commanding General, Army Air Forces, have research and development responsibility, including designation of military characteristics, for all guided or homing missiles dropped or launched from aircraft.

2. That the Commanding General, Army Air Forces, have research and development responsibility for all guided or homing missiles launched from the ground which depend for sustenance primarily on the lift of aerodynamic forces.

3. That the Commanding General, Army Service Forces, has research and development responsibility for guided and homing missiles launched from the ground which depend for sustenance primarily on the momentum of the missile.[2]

The Army Service Force interpreted this directive very loosely and so continued to work on development of its rocket program.

The biggest boost to the Army's rocket program came between 1945 to 1948 when they carried out "Operation PAPER CLIP." "The U.S. Army mounted an extensive effort in the closing days of the war to ensure that the United States received the benefit of the German rocket

expertise."[3] This operation moved 492 German and Austrian rocket scientists, along with some of their equipment, rockets, and documents, to the United States. The military divided this number of scientists among the different services with the Army receiving 177 rocket specialists, the most notable of these being Dr. Wernher von Braun. These scientists continued their research at the Ordnance Research and Development Rocket Sub-Office which the Army established at Fort Bliss, Texas.

In April 1946, the Army launched the first of 64 reconstructed V2's from White Sands Proving Ground. Over the next six years, these launches carried instruments to conduct operational research into the performance of these rockets.

Post World War II

Following World War II, the U.S. military took the lead in developing rockets. One of these studies was lead by then Commanding General H. H. Arnold. "An Army Air Force Scientific Advisory Group study which was commissioned by General H. Hap Arnold reported in 1945 that long-range rockets were not only feasible but also that artificial satellites were a 'definite possibility'."[4] Unfortunately, the defense budget was dramatically reduced as the nation demobilized. This budget reduction caused the military rocket supporters to compete for limited funds with proponents for proven military systems. These rocket supporters were dealt a serious blow when, in December 1945, DR. Vannevar Bush, Chief, Office of Scientific Research and Development, War Department, testified to Congress that it would be many years before it would be possible to develop a long-range rocket. His testimony resulted in a lack of funding support for rocket development in the late 1940s.

Despite the lack of funds the Army continued to conduct research into passive use of space. In January 1946, the Army Signal Corps reflected a radio signal off the moon and received

it back on Earth. This process was used to communicate between Hawaii and Washington, D.C. This reflective technique was not an effective means to communicate due to its many restrictive conditions, but it did show how radio transmissions pass through space and can return to Earth.

A number of studies were conducted during the late 1940s to study the feasibility of developing an American satellite. "General Arnold's own 'War Report' recommended that the Army Air Force (AAF) pursue the development of such missiles (artificial satellites)."[5] In May 1946, the World Circling Spaceship study was released by RAND proposing an American satellite. Although the study highlighted the feasibility and utility of civil and military applications in space, the recommendations were not implemented.

Also in May 1946, the War Department Equipment Board concluded that tactical missiles would play an important military role in the near future. It warned that the U.S. should continue to fund research and development to ensure its lead in rocket development.

The National Security Act of 1947 established the Department of Defense and organized the Air Force as a separate service. This reorganization resulted in the Army Air Corps providing most resources to the new service.

The 1950s

As the Army moved into the 1950s, it relocated its missile development group from White Sands to Redstone Arsenal in Huntsville, Alabama, and formed the Army Ballistic Missile Agency. "This agency was given the responsibility for design of future ballistic missile systems, including - the Amy hoped - a new family of rockets with intercontinental range, the ICBMs."[6] The U.S. Army launched its first Bumper WAC missile from Cape Canaveral, Florida, in October 1950.

The 1952 tests of thermonuclear devices on Eniwetok Atoll in the Pacific Ocean emphasized to the Army and the other services the importance of missile research. Following

World War II, critics argued against the ballistic missile claiming its cost, lack of accuracy, and small yield made the missile inferior to a manned bomber. The Pacific test results supported the contention that light thermonuclear weapons of enormous power and relatively low cost would eliminate the need for high accuracy and would make ballistic missiles equal, if not superior, to bombers.[7]

The Army Ballistic Missile Agency developed the Redstone rocket as both a tactical missile and a space launcher. On 20 August 1953 Cape Canaveral saw the launch of the first Redstone rocket. Meanwhile the Air Force and the Navy were busy developing their specific missile systems. The Air Force was working on the Atlas as an Intercontinental Ballistic Missile (ICBM) and the Navy was working on the Vanguard rocket.

The announcement by an international committee of scientists responsible for planning the International Geophysical Year (IGY) stirred commitment to the placement of a satellite in orbit. This group of scientists designated the orbiting of small satellite vehicles to obtain scientific information about the upper atmosphere as a key objective of the IGY.[8]

President Eisenhower called for the United States to place a satellite in orbit as part of the International Geophysical Year 1957-1958. All three services had different proposals for the launch vehicle: the Army with a modified Redstone rocket, the Air Force with its Atlas, and the Navy pushing its new Vanguard rocket. The civilian character of the IGY effort concerned Eisenhower and meant that the United States space program must be free of a military character.[9] Thus, the Eisenhower administration decided to establish a policy of "Space for Peace," and use a non-military program to launch the first satellite. Unlike the other two options, Vanguard was not designed for a specific military mission and, therefore, it seemed better suited for its "peaceful" mission during the IGY.[10]

Without regard for the Vanguard program, the Army continued development of its long-range missile called the Jupiter. Based on the Redstone missile, the Jupiter was a liquid fueled, multi-staged missile capable of reaching 1500 miles. A Jupiter C, on 20 September 1956, an elongated Redstone missile with solid fuel upper stages achieved a range in excess of 3000 miles and an altitude of 600 miles. In fact, to prevent the missile from entering space the fourth stage we inert. .This launch convinced the Army Ballistic Missile Agency scientists that the Army had the capability to reach space and to orbit a satellite.[11] Subsequent tests of the final Jupiter design in the spring of 1957 convinced Army officials that the problem of space flight could be solved.[12]

First Satellite

The Soviet Union launched the world's first artificial satellite, Sputnik I, on 4 October 1957. The United States and the rest of the world were shocked. No one believed that the Soviet space program was advanced enough to develop and launch a rocket.

Less than one month later, on 3 November 1957, the Soviets launched their second satellite, Sputnik II, into orbit. This satellite was much larger and included a passenger, a dog named Laika. The additional life support and instrumentation equipment required for this flight demonstrated that the Soviets could orbit and deorbit a satellite at will.

This second successful Soviet launch, along with the dismal failure of the first Vanguard launch before a world audience in December 1957, caused President Eisenhower to direct the Army to orbit a satellite by March 1958. After the Vanguard failure, the Soviet Union offered to aid the United States in its space program through a plan the Soviet Union presented to the United Nations aimed at providing technical assistance to backward nations.[13] This offer increased the emphasis to immediately put a satellite into orbit.

U.S. Army Launches First U.S. Satellite

As part of the International Geophysical Year and in response to the Soviet's success in launching Sputnik I, the army launched the first U.S. satellite, Explorer I, on a Jupiter C rocket on 31 January 1958. The small satellite transmitted for four months providing scientific data. The most important data led to the discovery of radiation belts around the world. These belts were called Van Allen radiation Belts after Dr. Van Allen of IOWA University, who designed the instruments.

Early Satellites

Despite early failures, Vanguard did have a successful launch on 17 March 1958. On board Vanguard I was an instrumentation package that transmitted data for six years. The Army launched the Explorer III satellite on an Army Juno rocket from Cape Canaveral on 26 March 1958. What was unique about this satellite was that it carried a tape recorder so that data could be stored on the satellite and then transmitted when the satellite came within range of a satellite ground station.

Although the Army's launch program was an overall success, there were several setbacks during this time frame. A Jupiter C carrying the Explorer II satellite failed to achieve orbit on 5 March 1958. Later in that year the Explorer V (on 24 August) and Beacon I (on 23 October) failed to achieve orbit.

The Army launched its last Explorer satellite, Explorer VII, on 13 October 1959. Instruments on board studied x-rays emitted by the sun and their influence on the ionosphere. It also identified the heavy particles that make up cosmic rays and also measured the heat emitted by the Earth.

NASA - U.S. Space Program Development

As the services' space programs continued to develop, concerns arose as to the competition among them. President Eisenhower tasked Dr. James R. Killian, president of the Massachusetts Institute of Technology, to study this situation and make recommendations to him. After studying the President's inputs, Dr. Killian recommended the establishment of a civilian agency to handle all aspects of research and development. The space program would be guided by civilian scientists.

President Eisenhower directed the establishment of the Advanced Research Projects Agency (ARPA) within the Department of Defense to manage all U.S. space activities. This was only logical since the military, at this point, controlled all the nation's existing space capabilities.[14] ARPA was approved by the President and became the first U.S. Space Agency. This plan did not last long as Congress and the public wanted a civilian space agency.

Five options emerged from various proposals before Congress and within the administration for space management.[15] These five options included:

1. The establishment of a single agency managed by the military, most likely the Air Force, which would control all government programs in space.

2. The creation of a cabinet level Department of Science and Technology to manage the civilian space effort.

3. The assignment of space to the Atomic Energy Commission.

4. The assignment of space activities to the existing National Advisory Committee on Aeronautics (NACA).

5. The creation of a civilian agency with the responsibility for government space activities except those specifically related to defense.

On 2 April 1958, President Eisenhower made his decision and sent his proposal to capitol hill. In June 1958 the National Aeronautics and Space Act was adapted. This Act clearly stated

that, "It is the policy of the United States that activities in space should be devoted to peaceful purposes for benefit of all mankind." The defense department was left to manage only those space activities "peculiar to or primarily associated with the development of weapon systems, military operations, or the defense of the United States."[16] This act created the National Aeronautics and Space Administration (NASA) which was granted research, development, and management responsibilities for all non-military activities in space.[17]

The military services, however, continued their work. The Air Force continued to develop ICBMs and the Navy continued development of sea-launched rockets. The Navy did transfer Project Vanguard and part of the Naval Research Lab to NASA. The Army continued to develop and improve its launch capability and produced the Juno II rocket. The Juno II was an original Sergeant missile top stage on a Jupiter bottom (first) stage. On 6 December 1958, an Army Juno II rocket launched the Pioneer III lunar probe for NASA. This satellite did not reach the Moon but did gather radiation data that proved the existence of a second radiation belt around the Earth.

In June 1958, the U.S. Army Signal Research and Development Laboratory (SRDL) at Fort Monmouth, New Jersey, was directed to construct a communication satellite that would be launched on an Air Force Atlas ICBM. By December 1958, the Army's SCORE (Signal Communication by Orbiting Relay Equipment) satellite was ready for launch. At the last moment, President Eisenhower was persuaded to record a Christmas message to the World. On the morning of 18 December, the Signal Corps loaded President Eisenhower's message into the communications package on the rocket. Once launched, the satellite passed over California but failed to respond properly. The next day, 19 December, the backup tape recorder transmitted the President's message to the World.

> This is the President of the United States speaking. Through the marvels of scientific advance, my voice is coming to you from a satellite traveling in outer space. My message is a simple one: Through this unique means I convey to you and all mankind, America's wish for peace on Earth and goodwill toward men everywhere.[18]

The SCORE package continued to work for 12 days transmitting between ground stations located in Georgia, Texas, Arizona, and California. The Army's SCORE satellite was the first communications satellite.

In 1959, a number of launches occurred. In February, a Vanguard II satellite was launched. The satellite carried an Army-developed cloud imaging sensor. The satellite wobbled uncontrollably and thus made imaging impossible. Also in February, the Discoverer I satellite was launched making it the first polar satellite. The satellite carried a camera and an ejection film system that allowed a canister to reenter the atmosphere and be recovered. Again misfortune occurred when the ejection system malfunctioned. In March, an Army Juno II rocket launched Pioneer IV toward the Moon. Pioneer became the first free-world artificial satellite to orbit the Sun.

Finally, in October 1959, the Army Ballistic Missile Agency launched Explorer VII for NASA using a Juno II rocket. The Juno II rocket technology would be used for subsequent deep space explorations. The Juno V rocket eventually became known as the Saturn I. NASA would eventually use this booster technology in launching heavy unmanned satellites and manned spacecraft.

Army Loses Rocket Programs

As the decade came to a close, so did the Army's prominent role in space. In 1958, the Army Ballistic Missile Agency transferred the Jupiter Intermediate Range Ballistic Missile (IRBM) program to the Air Force. In November 1959, the Army transferred its Saturn rocket program to NASA. With Saturn went the Von Braun engineering team and the heart of the Army's space program.[19] Also in 1959, the Army transferred most of the Army Ballistic Missile Agency, the Explorer satellite program, and the Jet Propulsion laboratory to NASA. This transfer had a

dramatic impact on the Army's space program because it included 2,327 rocket and satellite specialists. The Army lost most of its space capability. In fact, it only retained proponency for ballistic missile defense and the development of the Pershing I rocket. The White House press spokesman admitted at the time that the effect of the move was "to take the Army out of the field of space exploration."[20]

The 1960s

U.S. Army Satellite Development

During the 1960s, the Army developed new and more advanced satellites. The Television and Infrared Observation Satellite (TIROS) was launched on 1 April 1960, marking the first U.S. weather satellite in orbit. The TIROS I carried a television camera that transmitted the first television pictures of the Earth from space. Both the Army Signal Corps and the Army Ballistic Missile Agency helped develop the TIROS satellites.

On 4 October 1960, the Army's COURIER IB communications satellite was launched into orbit. The COURIER 1A satellite failed to orbit on 18 August 1960 after its launch vehicle exploded shortly after lift-off. The COURIER 1B was the first communications satellite to be powered by long-life solar cells recharging nickel-cadmium storage batteries. The storage and transmission capability were vastly improved over the earlier SCORE satellite.

Manned Space Flight

Manned space flight began on 12 April 1961 when Yuri Gagarin became the first man in space. At this point the United States was not far behind the Soviets and on 5 May 1961, Alan Shepard became the first American to make a sub-orbital flight into space. A modified Army Redstone rocket was the launcher. On 21 July 1961, Virgil Grissom became the second astronaut

to accomplish a sub-orbital Mercury mission, once again on an Army Redstone rocket. On 20 February 1962, John Gleen became the first American to orbit the Earth.

Years earlier, in January 1959, NASA had developed the selection criteria for astronauts. One of the most restrictive requirements was that all astronauts had to be experienced test pilots. This criterion prevented Army personnel from selection as astronaut candidates. In 1964 NASA changed the requirements and dropped the test pilot experience from its criteria.

Space Role Assigned to U.S. Air Force

Another change occurring in the early 1960s was the changing roles and missions of the different services. The Department of Defense gave the mission of operating and managing U.S. military space launch vehicles and satellites to the Air Force in 1961. The Defense Communications Agency (DCA) was formed in the early 1960s and assumed most of the Army's role as a developer of communication satellites. This organization was followed in 1962 by the creation of the U.S. Army Satellite Communication Agency. These new agencies limited the Army's role to ground terminals and ground support for space systems.

The U.S. Army continued to build and to operate most of the ground stations for satellite platform control and payload control. The Army controlled the first geostationary communication satellite, SYNCOM III, which was launched in 1964.

In 1966, the first eight of twenty-six Initial Defense Satellite Communications System (IDSCS) military communication satellites were launched. The full constellation allowed continuous communication between two points separated by 10,000 miles. The Army developed the 40-foot steerable antennas required to receive voice transmissions.

The 1970s

Army TENCAP Initiative

One of the largest contributions the Army made to space exploitation was the establishment of the Army Tactical Exploitation of National Capabilities Program (TENCAP). In the early 1970s there was concern that, despite the U.S. capability to provide essential capabilities to national, strategic, and some operational levels, the tactical user was not provided adequate access to classified systems and data. The Army took the lead in providing developmental equipment to support selected battlefield commanders. The Army Space Program Office (ASPO) continues to manage and develop receivers, transmitters and processors for Army units.

The 1980s

As the 1970s came to a close, NASA was selecting the first Army astronaut. After completing the rigorous preparation and training program, LTC Robert L. Stewart became the first Army soldier to go into space.

Army Soldiers in Space

LTC Stewart was a mission specialist on the tenth shuttle flight from 3-11 February 1984. LTC Robert Stewart and Astronaut Bruce McCandless became the first two untethered human satellites to move away from the shuttle by using the Manned Maneuvering Unit (MMU). LTC Stewart flew on a second shuttle mission on 3 October 1985, performing experiments and releasing two military satellites.

LTC Sherwood "Woody" Spring was a mission specialist on the shuttle from 27 November to 3 December 1985. During this mission he performed numerous experiments and deployed three communication satellites.

With the increase of Army personnel involved with space activities, the U.S. Army Space Agency's NASA Detachment was established at Johnson Space Center, Houston, Texas, in January 1987. Later in that year, the Army briefed the DOD Military-Man-in-Space Prioritization Board on two experiments, Terra Scout and Terra Geode.

Other Army Astronauts who have flown are: LTC James C. Adamson was a mission specialist on the shuttle from 8 to 13 August 1989; and MAJ Charles "Sam" Gemar was a mission specialist on the shuttle from 15 to 20 November 1990. Also, two Army officers were on the same shuttle flight in November 1991. LTC James Voss and CW3 Tom Hennen performed experiments, and CW3 Hennen performed the Army Terra Scout experiment. The A552, Space Operations, elective has been very fortunate to have both LTC Voss and CW3 Hennen give presentations to the class. Also LTC Spring and LTC Gemar have presented briefings to the entire CGSC student body.

Army Space Organizations' Development

The evolution of the different space commands was a long and, for the Army, a very complicated process. The first space command activated was the U.S. Air Force Space Command at Peterson AFB, Colorado, in September 1982. At that time, the Air Force had the bulk of space assets and responsibilities.

In 1983, a number of events occurred that would shape future space organizations. In March, President Ronald Reagan announced the Strategic Defense Initiative concept. This initiative shifted U.S. philosophy from that of massive nuclear retaliation to one of nonnuclear, active defense to protect the United States against attack. In response to this announcement, DOD formed the Strategic Defense Initiative Organization (SDIO) to develop the program.

Later in 1983, the Vice Chief of Staff, U.S. Army (VCSA), formed the Army Space Council to meet periodically to discuss, develop, coordinate, and approve proposals and provide guidance on Army's use of space. The Army Space Executive Working Group was formed to coordinate and work on space related actions, including those that would be presented to the Space Council. As early as 1983, one can see the overlapping layers of organizations developing in the Army dealing with space.

In 1984, the Army Science Board studied the Army's use of space to support its mission. It reported that the Army made minimum use of space capabilities and had no influence in the design and operation of most space systems.

The Training and Doctrine Command became involved in 1985 and directed the establishment of a Space Directorate at Fort Leavenworth. The members of this directorate, assigned to the Combined Arms Combat Developments Activity (CACDA), were tasked to develop concepts, doctrine, and operational requirements for using space to support Army operations.

In May of that year the VCSA formed another special study group to analyze how the Army should use space. The Deputy Chief of Staff for Operations and Plans (DCSOPS) directed the establishment of the Army Space Initiatives Study (ASIS) to develop a plan for future Army involvement in space that would enhance Army operations around the world.

Other activities include the U.S. Army Strategic Defense Command activation on 1 July 1985, using the resources of the Army's Ballistic Missile Defense Command in Huntsville, Alabama. The Concepts and Space Directorates of CACDA provided an interim operational concept called Army Space Operations.

The DOD established the United States Space Command as a unified command at Peterson AFB, Colorado Springs, Colorado, on 23 September 1985.

In December 1985 the Army Space Initiatives Study group presented the results of this study. It concluded that space systems had great potential to enhance Army missions at all echelons. It found the development, coordination and use of space capabilities fragmented and shared among to many organizations in the Army. The study provided 203 recommendations.

Again, in 1986, a number of space activities were evolving. In June the CACDA Space Directorate was redesignated the Army Space Institute (Provisional) and the Space Division, Space and Special Weapons Directorate (DAMO-SWX) were established within DCSOPS, HQDA. In August, the Army Space Planning Group at Peterson AFB, Colorado, was expanded into the U.S. Army Space Agency (USASA). The USASA was a field operating agency of the DCSOPS, DA. As the Army's representative at the U.S. Space Command it was responsible for operations and planning for space systems support to Army forces around the world.

In October 1987, the U.S. Army Space Institute was organized at the Combined Arms Center, Fort Leavenworth, Kansas. It was responsible for the development and integration of Army concepts, doctrine, combat developments, operational requirements, training and personnel proponency associated with the Army's use of space.

In March 1988, Army Space Institute published a draft U.S. Army Space Architecture. The purpose was to acquire near term capability by purchasing existing receivers and processors, provide enhanced mid-term capability by developing improved processors and, in the future, participate in the design of the system to ensure satellites are suitable for the needs of the Army.

In April 1988, the Army Space Agency became the U.S. Army Space Command (USARSPACE) and became the Army component of U.S. Space Command. The USARSPACE is responsible for providing operational space planning and support to the Army along with the operation of the Defense Satellite Communication System Operations Centers.

Army Space Demonstration Program Development

The Vice Chief of Staff, U.S. Army stated in November 1986 that the Army lacked awareness of space capabilities. He directed that a Space Demonstration Program be developed. The purpose of the program was to demonstrate the capabilities of space system to provide support to tactical units in the Army. The Deputy Chief of Staff for Research, Development and Acquisition (DCSRDA) developed five proposed space demonstrations and presented them to the Space Council in April 1987.

At the same time, the Army Space Institute presented a briefing on the Army Space Concept. The VCSA directed the Army Space Institute to review the proposed space demonstration program and make sure it was in line with the space concept. The final version of the Army Space Demonstration Program was approved in August 1987. The initial program consisted of the following demonstrations:

1. Global Positioning System (GPS) Receiver Position/Navigation.
2. GPS Azimuth Determination.
3. Weather and Terrain.
4. Lightweight Small Satellite (Lightsat).
5. Theater Missile Defense Tactical Missile Detection.

As the 1980s came to an end, the Army Space Demonstration Program was busy demonstrating space equipment and products to units around the world. The Small Lightweight GPS Receiver (SLGR) provided tactical units with a hand-held accurate position and navigation receiver. WRAASE weather receivers were used to support Army division and separate brigades. A number of lightweight satellites were launched which had small UHF communication packages on them.

As 1990 arrived the Army Space Demonstration Program had demonstrated many prototype receivers and processors to units around the world. Many units deploying to DESERT SHIELD and DESERT STORM had participated in this demonstration program and were sold on the advantages and capabilities of space systems.

The 1990s

The 1990s erupted with space technology as the United States entered the Gulf War. Many of the products that units had practiced with and seen demonstrations of were now in high demand.

Operations Desert Shield/Desert Storm

Extensive utilization of space systems was needed to support all the units deployed to SouthWest Asia. Communication, weather, navigation, multispectral imagery, and early warning were key to our preparation and employment of forces in this conflict. Some of the systems the Army was involved with were critical to our success.

Along with Fleet Satellite Communications System (FLTSATCOM), International Maritime Satellite Organization (INMARSAT) and the International Telecommunication Satellite (INTELSAT), U.S. forces used the Defense Satellite Communication System (DSCS) to provide data circuits to pass voice, data and fax information to and within the theater of operation. The Army Space Command performed an essential role in the control of the DSCS communication payloads. A spare DSCS satellite was repositioned over the Indian Ocean so three satellites were available to support the operation. Satellite communications provided critical command and control links as units' organic communications were out paced during operations.

The USARSPACE and Army Space Institute personnel used commercially available hardware and software to process multispectral imagery to produce maps of Iraq and Kuwait. They used LANDSAT and SPOT satellite data to produce the map supplements.

As was mentioned earlier USARSPACE collected and distributed the SLGRs used in their Army Space Demonstration Program to units deploying to DESERT STORM. The USARSPACE personnel checked for proper working order, assembled a supply of batteries and, with HQDA Deputy Chief of Staff Operations, developed a distribution plan for units of the XVIII Airborne Corps: 82nd, 24th, and 101st divisions. The Army Space Institute provided the SLGR Training Manual and with USARSPACE trained the soldiers. These GPS receivers provided accurate positioning information, extremely accurate time, and a common map grid to its users.

The Army Space Program Office (ASPO) provided support to deployed units. Critical TENCAP systems deployed with U.S. forces.

Two Defense Support Program satellites provided early detection of Iraqi SCUD missile launches. Early warning data was relayed via satellites from the U.S. to Saudi Arabia and then to the Patriot air defense units.

Formation of U.S. Army Space and Strategic Defense Command

In August 1992, the U.S. Army Space and Strategic Defense Command (USASSDC) was formed by combining the U.S. Army Space Command and elements of the U.S. Army Strategic Defense Command. As a field operating agency of the Army Chief of Staff, USASSDC serves as "the Army focal point for space and strategic defense matters and is responsible for exploitation of space and strategic assets by warfighting commanders."[21]

The command has been assigned three missions:

1. Its Army Space Command arm serves as the Army component to the United States Space Command.

2. Its Strategic Defense arm serves as the focal point for strategic and theater missile defense technology base development in support of the Strategic Defense Initiative Organization.

3. Its operation of a national missile test range and a laser research facility supports space and strategic defense missions as well as other defense programs.[22]

Operation RESTORE HOPE

During Operation RESTORE HOPE in Somalia, space systems provided direct support to deployed troops. Like DESERT STORM, communication, weather, navigation, and multispectral imagery were all critical functions supported by space systems.

The Forces Command Emergency Operations Center initially alerted USARSPACE to be prepared to support units deploying to Somalia. When the units selected for deployment switched from the XVIII Airborne Corps to the 10th Mountain Division, USARSPACE sent upgraded SLGR sets, INMARSAT terminals, a multispectral imagery processor, Seaspace weather receiver equipment along with the trainers within 36 hours to Fort Drum, NY.[23]

Operations in Today's Changing Environment

As U.S. forces continue to be involved in actions throughout the world the support of space systems to deployed soldiers continues to be a critical necessity. When soldiers deploy into the island nation of Haiti to restore democracy, or enter the war torn Bosnia-Herzegovina for Peacekeeping, or participating in Noncombatant Evacuation Operations in Liberia the use of space systems is critical for success of these operations. Communication, weather, navigation, and

multispectral imagery are all critical elements that deployed soldiers need that are supported by space systems.

Importance of Army's Space Effort

The importance of space operations to the Army and the need to educate our future leaders in this critical area can be highlighted by the success the Army had in DESERT STORM using space assets. General John R. Galvin, Commander in Chief, European Command, stated,

> Space assets played, and will continue to play, an extremely vital role to the Army warfighter. . . . space systems support across the entire battlefield spectrum; from the Theater Commander down to Special Forces soldiers in enemy territory. With a sound understanding of the variety of space systems and their capabilities, our future operations will be even more successful.[24]

General Crosbie E. Saint, Commander in Chief, U.S. Army Europe stated, "I cannot overstate the importance of space based technology to Army warfighters. We need to 'beat the drum' for continued achievements in this area."[25]

CHAPTER 4

RESEARCH DESIGN

I conducted a formative evaluation on this three-hour core lesson to see if there is a need to improve it from the view point of the commanders who have CGSC graduates on their staffs. A more critical review was also accomplished with the graduates after they were in follow on assignments for six months. I used an objective-based model to determine if the school's stated goals and objectives are being met. I measured these objectives by comparing what commanders and staff members determine CGSC students need for a good foundation in space operations with what CGSC has outlined for their students to learn in this lesson. I also looked at what the students actually learned in this three-hour lesson and what they see as necessary out in the units.

Phase I: Development of Army CGSC Space Curriculum

Interview Department of Academic Development and Department of Joint and Combined Operations core course and lesson authors to determine how the number of hours are determined and how the depth of lesson knowledge is established for each lesson.

Phase II: Discussion of Other Intermediate Service Schools Space Curriculum

Analyze what the other intermediate service schools teach their students and determine if it is appropriate for CGSC. Analyze the other service schools on how they make decisions on the type of space curriculum and the number of course hours taught to students.

Phase III: Matrix of specific space-related curriculum taught at the different intermediate service schools

I developed a matrix which compares the space-related topics that the different intermediate service schools teach. I compared the amount of time, divergence of topics, and depth of material covered by each school.

For the next four phases, I developed questionnaires to determine the type and level of knowledge needed by CGSC graduates about space systems, requirements to access them, and any other appropriate data needed to determine a sound space foundation. To develop my questionnaires, I used a clear, precise definition of my goal. I had Dr. Lowden, the Department of Academic Development at CGSC, review my questionnaires. I had him explain the questions and interpret them so the meaning of each question was clear. I pretested the survey on a small sample of students and faculty to ensure its clarity.

The first questionnaire was a one page instrument which I provided to one division of CGSC students at Fort Leavenworth. I did this for both the Academic Year 1992 to 1993 and the Academic Year 1993 to 1994 students, generating data for two school years. A return rate of 48.1 percent for Academic Year 1992 to 1993 and 57 percent for Academic Year 1993 to 1994 were received from the students.

This questionnaire was divided into four sections. Part I was a general description of the questionnaire's purpose and goals. Part II was to determine if the students had any space experience. Part III was to determine the student's knowledge of space system and operations. The last section was to determine the student's ability to access space systems, products, and their integration into military missions.

The second questionnaire was developed to determine what core and elective courses the departments teach which include space in any format and if there is any plans to include space in any future courses.

The third questionnaire was developed to determine what type and level of space knowledge a graduate needs from the perspective of a commander dealing with soldiers and space operations. The third questionnaire was divided into four sections. Part I was a general description of the interviewee (service, branch, command experience, space experience) to determine the interviewee experience and expertise. Part II was used to determine the interviewee's knowledge of space operations (closed questions about types of space systems, types of functions, procedures to access systems). Part III was closed questions on the expected level of knowledge of a CGSC graduate in regards to space operations (space functions, space systems, space requirements, and access to space systems products). The last section was closed questions on the appropriate level of space knowledge for a member of their staffs.

The last questionnaire was developed and sent to graduates six months after arriving at their new assignment to determine what level of space knowledge a graduate retains after leaving CGSC. This allowed the graduate's time to become familiar with their new job and allow them to understand the requirements and expected procedures they require to accomplish their duties. This questionnaire was divided into four sections. Part I was a general description of the graduate (service, branch, current duties, space experience). Part II was used to determine what level of space curriculum did they retain after six months. Part III was used to determine what space systems and products did they require and also if they knew where to go to access space products for their current duty position. The last section was open questions which allowed the graduates to express, from their duty position perspective, what type of space knowledge did they really need to accomplish their assigned duties.

Phase IV: Development of Student questionnaire on their knowledge of space-related curriculum

I used the above-described questionnaire to obtain what the students perceive as the appropriate type and depth of space curriculum required for this school. This questionnaire also was to determine if they received an appropriate level of space curriculum in the current three hour lesson.

Phase V: Development of CGSC Directors questionnaire on space-related curriculum

I used a second questionnaire to determine what, if any, space information is currently incorporated and what space information is going to be incorporated into the other CGSC department curriculum.

Phase VI: Discussion with Lieutenant General Donald M. Lionetti and questionnaire with Colonel James W. Kulbacki, Army Space Command, on space instruction for intermediate service school graduates

Held a discussion with Lieutenant General Lionetti during his visit to speak to the CGSC student body allowed me to determine what he expects of each graduate of CGSC to know about space when they leave Fort Leavenworth. Colonel Kulbacki's questionnaire results also provided senior level perspective on what CGSC graduates need to know about space.

Lieutenant General Lionetti was the Commander, U.S. Army Space and Strategic Defense Command. The U.S. Army Space and Strategic Defense Command manage the Army's missile defense research and technology activities for the Ballistic Missile Defense Organization, Huntsville, Alabama. The command also operates the U.S. Army Kwajalein Atoll as a National Missile Range.

General Lionetti has had a long career in space and air defense artillery. From serving as assistant professor, Department of Earth, Space, and Graphic Science at the U.S. Military

Academy, to the commander of an Air Defense Artillery Battalion and Brigade, he has been involved with space. His early career also included service at a North American Aerospace Defense (NORAD) control center and site duty with a NIKE-Hercules strategic air defense system.

Recently, he was the Director for Plans (J-5) of U.S. Space Command, Peterson AFB, Colorado Springs, Colorado, from 1988 to 1989: Commanding General and Commandant of the U.S. Army Air Defense Artillery School, Fort Bliss, Texas, from 1989-1991; and Deputy Commanding General and Chief of Staff at the U.S. Army Training and Doctrine Command, Fort Monroe, Virginia, from 1991 to 1992. General Lionetti assumed command of the U.S. Army Space and Strategic Defense Command on 24 August 1992, bringing an education as well as an air defense and space background.

Colonel James W. Kulbacki was Deputy Commander for Support, U.S. Army Space Command. His background as a signal corps officer serving as a company and battalion commander significantly contribute to his space expertise. Colonel Kulbacki served as the Theater Tactical Operation Chief in the U.S. Army Information Systems Command and also completed a tour in the Command, Control, and Communication Directorate of the Joint Chiefs of Staff, Washington, D.C. Colonel Kulbacki has in-depth knowledge of communication systems, products, and integration of these systems with other space products.

Colonel Kulbacki's duties at U.S. Army Space Command included responsibility for all support functions for Army Space Command. His communication background, including his detailed knowledge of satellite communication systems and his role in integrating space support throughout the Army, makes him an ideal individual to interview about CGSC graduates knowledge of space.

Phase VII: Development of CGSC graduates questionnaire on the actual space knowledge required to accomplish their military mission.

This last questionnaire was used to obtain from CGSC graduates the level of knowledge a graduate retained after leaving CGSC and going to an operational assignment. This survey also showed the actual type and depth of space knowledge they require in their assigned duties. This questionnaire is the critical link between what academia and students think they might need and the actual level of space systems knowledge, products, and accessibility that a mission ready soldier realizes he needs. The questionnaire was sent to 106 students (10 percent) of the Academic Year 1993 to 1994 graduates. The actual graduates were selected on a random basis using a computerized list of graduates. What makes this questionnaire so valuable is because I am no longer testing students expected level of knowledge but I am testing the graduates actual knowledge 6 months after they graduate. This survey also shows which space functions are being utilized by soldiers in the field.

CHAPTER 5

ANALYSIS

As I began to analyze the data collected for this study I wanted to ensure I answered my three secondary research questions found in Chapter One but also ensure that I address my primary question: "Does CGSC devote time, resources, and personnel to teach students an appropriate level of space-related curriculum?" I will cover these questions in the next two chapters as I disclose the information gathered from my research.

I first examined how the current curriculum is developed at CGSC and the other intermediate service schools. Secondly, I reviewed course material to determine the course development procedures, and compared them with CGSC's lesson development procedures. I then used my questionnaires to determine the students' level of space knowledge and what the commanders expect the students' knowledge to be. Lastly, I obtained from the graduates out in units what space knowledge they needed to accomplish their assigned missions.

Development of Army CGSC Space Curriculum

Upon speaking to the core course authors for the Department of Joint and Combined Operations (DJCO), they were not able to describe a coherent, developed program to assess course needs and development. The core courses are evaluated by the previous student class' ACCESS reports on how the course was presented. No author/instructor could describe how CGSC conducts a need's assessment to provide a logical, documented assessment of what is needed in a

course. The changes to course material were done by the course and lesson authors and not based on any formal analysis that identified a change in requirements for that course.

A good example of what occurs to different lessons is the reduction in lesson hours. The changes in the number of hours in a course, driven by such things as limiting the number of days for a course or the number of contact hours for the students, were made by the course and lesson authors without any critical analysis as to which lessons were more important or beneficial to the students.

The current space curriculum has evolved over the last few years. The first year that any space curriculum was offered at CGSC was the 1989 to 1990 school year. The subcourse, P551, U.S. Army in Space, examined:

> U.S. Army doctrine and operations in space, and Army involvement in the Strategic Defense Initiative (SDI). Emphasis was given to the joint aspects of the mission, organization, and role of the Unified Space Command. Air Force and Navy launch and satellite systems were also described and evaluated.[1]

The means of presentation were two, two-hour lectures at class level (all students in Eisenhower auditorium). This introduction to space was a result of the Chief of Staff, U.S. Army, directing that space be included in the education of Intermediate Service School (ISS) students.

In Academic Year 1990 to 1991, DJCO continued with the four-hour separate subcourse called P551, U.S. Army in Space, which included a separate syllabus book and readings completed prior to a four hour presentation by guest speakers. Two hours were given by Army astronaut Colonel Robert L. Stewart who spoke to the class about his role as the first Army astronaut. Another two hours were presented by the Army Space Institute (Fort Leavenworth), on space support to the Army.

Academic Year 1991 to 1992 took a slightly different approach. Emphasis was given to providing space training to all students. The purpose of this subcourse was to: "develop a

fundamental understanding of military applications of space, roles of the U.S. Army in space, and how military space systems enhance deterrence and strengthen U.S. warfighting capabilities."[2] Four hours of lecture were divided between two lessons. Lesson One was a two-hour lecture at class level providing an overview of U.S. Army organizations involved in space, the U.S. Army's mission in space, the U.S. Army's space concept, and current and future capabilities available to the U.S. Army warfighters. Lesson Two was a two-hour lecture at division level (300 students) designed to build on previous information in lesson one, focusing on current and future U.S. space capabilities and systems and how space support can be obtained.

Lieutenant General Robert D. Hammond, Commander, U.S. Army Strategic Defense Command, spoke on the Strategic Defense Command and the Army's involvement in space research and development. The other two hours provided time for Colonel Michael W. Keaveney, Commander, U.S. Army Space Command to discuss and answer questions about how space can support the tactical Army today.

At the close of the 1991 to 1992 school year and in preparation for the development of the 1992 to 1993 curriculum, the lesson and course authors were asked to provide an analysis of how many hours they would need for their lessons. With the space curriculum being incorporated into C5000, Space Operations, I reviewed the ACCESS reports and determined that the students wanted more of a hands-on application and discussion of what space can do for them. This was a natural response of many students who had served in DESERT STORM and had experienced first hand how space systems could support their warfighting duties.

The analysis showed that the lesson author would still use a senior Army space expert (Army Space Command, Strategic Defense Command, Army Space Division-Pentagon) to provide the National and DOD space policy and doctrine along with the Army's policy. The other four hours were going to: (1) introduce some of the systems involved in force enhancement of space

(communication, navigation, weather, multispectral imagery, and missile warning); (2) discuss the contributions these systems could make to assist soldiers; and (3) provide the students a scenario to show them how to use space assets to assist them during the different phases of an operation (predeployment, deployment, employment, and redeployment).

Although this analysis took into account the students' comments, the instructors' inputs, and the lesson author's insights, the five hours were not allocated to space curriculum. The course author had to reduce hours to fit the course within a selected number of days. The course author, along with the other lesson authors, determined that the other lessons were more important. This determination was not based on any documented analysis of need but on a perceived lack of need of space knowledge. The five hours requested were cut to three.

Academic Year 1992 to 1993 space curriculum focused on an introduction to how space systems support U.S. national security and U.S. military operations. Due to the limited time for the lesson, the students were expected to know the missions and roles of the different space organizations from their readings. This sub-course included a one-hour guest speaker and two hours of classroom discussion/practical exercise. The 1992's guest speaker was a brand new arrival at the Department of the Army, Space and Special Weapons Division at the Pentagon. The General Officer who was requested could not make the trip. As the Major presented the briefing, it was obvious that this was the first time this material was ever presented. The presentation on National, DOD/JCS, Army space policy, and the Army Long-Range Plan for Space was not well received by the students. The students critique forms reflected a disappointment in the space curriculum.

The remaining two hours for 1992 to 1993 school year were presented by five DJCO instructors augmented by staff members of Army Space Institute (ASI). The ASI contributed to the review of the different systems and products available under force enhancement. The

discussion was well received and the practical exercise, which was built around a Korean crisis situation, challenged the students to discuss, evaluate, and select the most appropriate system to fit their needs. The student critiques emphasized the importance of this type exercise but wanted space curriculum spread throughout the school year and not just three hours in one or two days.

The Academic Year 1993 to 1994 space curriculum was to provide students a basic knowledge of how space systems support military operations. The lecture-conference and practical exercise provided an overview of space-based capabilities and assets available to support the military commander. Due to the limited time allowed to conduct this lesson, students were expected to gain the bulk of this knowledge through the readings assigned in the lesson.

Hour one included a one-hour guest speaker from U.S. Space Command who discussed the missions, organizations, and functions of USSPACECOM, space policy, and how space systems support military operations. He also discussed the use of space assets during four phases of an operation: Force enhancement, force application, space support, and space control. Although this briefing was very detailed, it was not relevant to an Army officer leaving CGSC to become an operations officer or executive officer of a battalion or brigade. The remaining two hours were at staff group level, using twenty instructors to discuss space-based systems, products, and how to access them. They facilitated this discussion using a practical exercise of Korea.

This analysis of how the space curriculum was implemented and how it has evolved over the past five years revealed that the lesson authors are restricted by the issue of time to teach anything beyond a very basic introduction to space. The three hours allocated does not allow enough time for the instructor to explain in any detail the current systems available to corps, divisions and separate brigades. Nor does it allow for development of any discussion of future systems which are being developed, researched or demonstrated today.

As can be seen no formal college or department level evaluation is conducted to determine the proper amount or level of space knowledge required by soldiers in units. This lack of evaluation results in lesson authors responding yearly to current students who are not in a position to know what type and depth of space knowledge is required for them to accomplish their warfighting mission.

Discussion of Other Intermediate Service School Space Curriculum

An analysis of the different Intermediate Service Schools (ISS) showed quite a divergent role for space in their curriculum. The Air Force offers a very detailed core course on space and is currently integrating space throughout the Air Command and Staff College Curriculum. They are developing this integrated curriculum with the assistance of GEO Dynamics Corporation of Colorado Springs, Colorado.

The Navy offers a limited space curriculum with a short, one and one-half hours of space curriculum and discussions. The Army offers three hours of core space curriculum that was described in the previous section.

The major criteria as to what ISS schools should offer in terms of space come from the Military Education Policy Document, released by the Chairman, Joint Chiefs of Staff, on 23 March 1993. This document requires the following criteria be taught for joint accreditation: (1) Know how the roles, functions, capabilities, and limitations of U.S. military forces (air, land, sea, space, and special operations) affect joint and combined operations; (2) Know the command structure, organizational concepts, and command relationships applicable to U.S. military forces (air, land, sea, space, and special operations) in selected joint and combined commands; and (3) Know how the U.S. national intelligence organizations and C4 systems support U.S. military commands during joint and combined operations.[3]

This portion of the study did answer the second, secondary research questions: "What level of space curriculum is being taught at the Air Force, Navy and Marine Corps Command and Staff Colleges and are these levels appropriate?" For the Air Force, the detailed core course and the well-integrated space curriculum is very appropriate for the service who controls, manages, and operates the majority of space assets for DOD. The Air Force is very active in integrating space throughout its aerospace doctrine so it is very appropriate that they integrate it into their educational foundation as well.

The detailed knowledge that the Air Force requires (i.e., Space Control and Space Support) is beyond what an Army officer requires since very few Army officers would ever be involved in these operations. I do believe, however, that the Army can learn from the Air Force on how they instruct force enhancement and force application. These are areas that Army officers utilized in DESERT STORM and will utilize in all future battles. The Air Force integrates space systems products, maps, imagery, and weather data throughout its core and elective courses. This continually exposes the students to space capabilities. Again this is an area that CGSC could learn from the Air Force.

The Navy has nearly the same type program that CGSC has and I was not able to determine if that was an appropriate level for their students. With the increase in space utilization aboard Navy vessels, one would believe that the Navy would want to ensure that their officers and commanders were aware of all the available systems, products and capabilities and any future developments.

Table 1 lists the space-related courses offered at the different intermediate service schools. This table also lists the required space material that is required by the Joint Professional Military Education.

TABLE 1

Matrix of Specific Space-Related Curriculum Taught
at Different Intermediate Service Schools

	Air Force	Navy	Army	JPME
Characteristics of Space.	Yes	Yes	No	Not Required
Advantages and disadvantages of satellite orbits.	Yes	No	No	Not Required
Comprehend mission and user requirements to select orbits.	Yes	No	No	Not Required
U.S. Force Enhancement satellite systems and their missions.	Yes	Yes	Yes	Not Required
Capabilities and limitations of satellite systems	Yes	Yes	Some	Not Required
Planned U.S. Force Enhancement satellite systems and missions.	Yes	Yes	No	Not Required
Describe mission and organization of U.S. Space Command.	Yes	Yes	No	Yes
Responsibilities/Components				
Air Force Space Command	Yes	Some	Some	Yes
Navy Space Command	Yes	Some	Some	Yes
Army Space Command	Yes	Some	Some	Yes
Comprehend space operations functions of force enhancement, space support, space control, and force application.	Yes	Yes	Some	Yes
Mission of SAC supported by space operations.	Yes	No	No	Yes
Mission of U.S. Navy supported by space operations.	Yes	Yes	No	Yes
U.S. military space systems enhance deterrence and combat effectiveness of air, land, sea, and space forces.	Yes	Yes	Some	Yes
Future space assets.	Yes	No	No	No
Known U.S. national satellite systems, missions, capabilities and limitations.	Yes	Yes	No	Yes
How national systems support broad mission areas.	Yes	Yes	No	Yes

I developed this matrix to compare the space-related topics that the different intermediate service schools teach. As you can see the Air Force incorporates all these areas into their curriculum. The Navy is the next service to incorporate a good number of these areas into their curriculum. The Army incorporates the least. The most significant information from this matrix is that CGSC does not include all the designated areas required by the Military Education Policy Document.

Results of Student Questionnaires on Their Knowledge of Space-Related Curriculum

Examining the two years of data and analyzing it in relation to students with and without a space background, there are some student perceived visible strengths and weaknesses in the current space curriculum. Weaknesses were identified by the students responding with a NO knowledge (no understanding of the system or program) or a WEAK knowledge (familiar with names of a few systems but no depth). A strength was identified by the students responding with a SOME knowledge (able to describe some of the systems and procedures), a STRONG knowledge (able to describe most systems and procedures in depth), or a VERY knowledgeable (outstanding knowledge of these systems and how to access them or there products).

In Academic Year 1992 to 1993 the questionnaire was completed at the end of the school year. The students had received their space instruction at the start of the school year, from August through September depending on their division. This long lapse of time was addressed in the additional remarks on the back of the questionnaire as a major concern. The students were concerned that "We get a quick introduction on space and then they go nine months without hearing the word 'space' mentioned again. If the school is not going to make an effort to include a subject then skip it all together, don't just check a box."[4]

Areas that received a 75 percent or higher negative response were categorized as weaknesses. An area that received a 35 percent or higher positive response was categorized as strengths. These percentage rates were selected by myself to try to capture any type of retained knowledge as a positive strength.

I received 130 returns out of 270 questionnaires which equates to a 48.1 percent return rate. Of these 130 returns, 10 of them were from students with a space background for a 7.7 percentage rate. The other 120 students had no space knowledge prior to CGSC for a 92.3 percentage rate.

The two areas that were identified as strengths were both under force enhancement:

1. The students had their greatest knowledge about the capabilities and availability of navigation systems. Use of the Global Positioning System (GPS) and the Navy Transit system received a 46.1 percent knowledge rating. This makes sense that the students knew about GPS from their involvement in DESERT STORM and GPS's wide utilization during the war.

2. The students also had a good knowledge about the capabilities and availability of products from the Intelligence Gathering Assets. This category received a 36.2 percent rating.

Areas that were identified as weaknesses by the students considerable outnumbered the strengths. Starting with the highest scores for lack of knowledge and working down they are:

1. Do you know how to get access to space systems? An astounding 86.2 percent did not know how to access the space systems that are available to them.

2. Do you know how to obtain space products? Again a very high percentage, 85.4 percent did not know how to obtain maps, photos, or communication channels that they could use for their warfighting duties.

3. Are you aware of DOD's future space program? A total of 83.8 percent of the students lacked knowledge of what future systems were being developed for their use.

4. Army Space Program Office duties? With the continuous demand for more access to national space systems, I was surprised to see that 82.3 percent of the students were not knowledgeable about the agency that provides TENCAP products to them.

5. Under force enhancement, the survey questioned knowledge about weather systems. The students responded with 80.8 percent of them not aware of the capabilities or available products from the defense Meteorological Support Program (DMSP), GOES or TIROS systems.

6. The next two areas were tied at 80 percent of the students having no or weak knowledge. The first one I could understand, although it was in the news a lot since 1983 when President Reagan announced "Star Wars." Students had weak knowledge of our missile defense programs. Specifically, they had little knowledge of the Ballistic Missile Defense programs, Theater High Altitude Air Defense (THAAD) and Global Protection Against Limited Strike (GPALS).

The second area that 80 percent of the students showed as a weakness was understanding the roles and missions of the Army Space Command. With this high a score for the second of four organizations, and a third one coming, I believe that having students read about the Space Command organizations without a classroom discussion of them does not allow students to fully comprehend the roles and missions that these organizations play in space.

7. Do you understand how military missions and satellite systems are integrated was identified by 79.2 percent as a weakness.

8. The last weakness identified was the lack of understanding of the roles and missions of the Strategic Defense Command. Here, 75.4 percent identified it as a weakness.

Table 2 provides a complete description of the questions and results of the student's questionnaire.

TABLE 2

Results of Questionnaire from Academic Year 1992 to 1993

	"NO"		"YES"	
Question	Number	Percent	Number	Percent
Do you have any space experience?	120	92.3%	10	7.7%
What is your knowledge of Communication Systems?	94	72.3%	36	27.7%
What is your knowledge of Navigation Systems?	69	53.1%	60	46.1%
What is your knowledge of Weather Systems?	105	80.8%	25	19.2%
What is your knowledge of Multi-Spectral Imagery Systems?	95	73.1%	35	26.9%
What is your knowledge of Intelligence gathering assets?	83	63.8%	47	36.2%
What is your knowledge of Ballistic Missile Defense?	104	80.0%	26	20.0%
What is your knowledge of the roles and missions of U.S. Space Command?	94	72.3%	36	27.7%
What is your knowledge of the roles and missions of Army Space Command?	104	80.0%	26	20.0%
What is the knowledge of the roles and missions of the Strategic Defense Command?	98	75.4%	32	24.6%
What is your knowledge of the roles and missions of Army Space Program Office?	107	82.3%	23	17.7%
Do you know how to get access to space systems?	112	86.2%	18	13.8%
Do you understand how military missions and satellite systems are integrated?.	103	79.2%	27	20.8%
Do you understand how our national space systems support military missions?	88	67.7%	42	32.3%
Are you aware of DOD's future space programs?	109	83.8%	20	15.4%
Do you know how to obtain space products?	111	85.4%	19	14.6%

Some of the concerns that were addressed in the remark's section of the questionnaire show the students' feelings on the space curriculum.

> Course presented was merely a run through and test designed to regurgitate systems. Course needs to be oriented on organization, how it supports the "Army/DOD" battle and how we can tap into the system, i.e., what can it do for me as a Commander and how to get it.[5]

> Our (U.S. Army) bias towards tactics and procedures ignore the ratio between the fighters and supporters. The myopic concentration of C310, C320 and A301 combined with C520 and C530 push the fighting/planning to the near total exclusion of supporting functions, short of a perfunctory look at logistics.
>
> The problem with any other option is the vast diversity of supporting functions and systems. Many officers have vast backgrounds in technical/specialized areas and their interest and/or ability to grasp and learn a new area is limited. The best could be an exposure to other areas for familiarization.[6]

> They are simply tools of the "elite" (i.e., SOF, two/three/four star flag/general officers, technically oriented service components--USAF, USN). I think we waste money developing them and then allow only a few to use their benefits. I have written my Congressmen and Senators to kill all SDI monies, space defense projects as they do not support the individual Battalion and Brigade fighter in the field beyond "sluggers."[7]

I do not know if we can change peoples' minds about writing their Senators but we can do something about the recognized weaknesses of our space curriculum. These areas that the students identified as weaknesses will be of interest when we look at what the Army space experts say are the areas that students should have knowledge of.

For Academic Year 1993 to 1994 the questionnaire was distributed to students at the end of January which appears to have allowed for some more retention of the material than if tested at the end of the school year. This time I received back 154 out of 270 questionnaires for a 57 percent return rate. The number of students with a space background doubled to 20 giving us 13 percent of the students with a space background and 134 or 87 percent without a space background. Complete results are in Table 3.

Academic Year 1993 to 1994 saw an increase from two to five areas identified as strengths. These areas were:

1. Under force enhancement, again students had the greatest knowledge about navigation systems. Rising from previous years' 46.1 percent to this years 61 percent knowledge rating.

2. Concerning the roles and missions of organizations, the students had a dramatic jump in understanding the U.S. Space Command organization. Almost half, 49.4 percent had an understanding of USSPACECOM roles and missions. This increase may have resulted from the guest speaker being from USSPACECOM.

3. Do you understand how our National Space Systems support military missions increased to 47.7 percent.

4. Do you understand how military missions and satellite systems are integrated, more than doubled to 43.8 percent knowledge rating.

5. The last strength identified was understanding the roles and missions of Army Space Command. Knowledge in USARSPACE's mission jumped from 20 to 38.3 percent.

With the increase in strength for Academic Year 1993 to 1994 also came a decline in weaknesses from eight to five. Starting with the highest score for lack of knowledge and working down they were:

1. Knowledge of missile defense programs, such as Ballistic Missile Defense, stayed high at 82.5 percent having no or weak knowledge of these programs.

2. Army Space Program Office was again a surprise with 79.9 percent not knowing the roles and missions of this agency.

3. Staying at the same spot was the awareness of DOD's future programs at 79.1 percent.

4. The question, "Do you know how to get access to space systems?" was still high with 77.8 percent having a weak or no knowledge.

5. The last weakness identified was not knowing how to obtain space products with 77.6 percent not able to get maps, photos, or communication channels.

TABLE 3

Results of Questionnaire from Academic Year 1993 to 1994

	"NO"		"YES"	
Question	Number	Percent	Number	Percent
Do you have any space experience?	134	87%	20	13%
What is your knowledge of Communication Systems?	100	65.8%	52	34.2%
What is your knowledge of Navigation Systems?	60	39%	94	61%
What is your knowledge of Weather Systems?	107	69.5%	47	30.5%
What is your knowledge of Multi-Spectral Imagery Systems?	104	67.5%	50	32.5%
What is your knowledge of Intelligence gathering assets?	104	67.5%	50	32.5%
What is your knowledge of Ballistic Missile Defense?	127	82.5%	27	17.5%
What is your knowledge of the roles and missions of U.S. Space Command?	78	50.6%	76	39.4%
What is your knowledge of the roles and missions of Army Space Command?	95	61.7%	59	38.3%
What is the knowledge of the roles and missions of the Strategic Defense Command?	104	67.5%	50	32.5%
What is your knowledge of the roles and missions of Army Space Program Office?	123	79.9%	31	20.1%
Do you know how to get access to space systems?	119	77.8%	34	22.2%
Do you understand how military missions and satellite systems are integrated?.	86	56.2%	67	43.8%
Do you understand how our national space systems support military missions?	80	52.3%	73	47.7%
Are you aware of DOD's future space programs?	121	79.1%	32	20.9%
Do you know how to obtain space products?	118	77.6%	34	22.4%

Some of the comments for Academic Year 1993 to 1994 in the remark's section stated these concerns:

> I think the presentations on space for Division A turned a lot of people off to space. We do not stress the common user level of what is available.[8]

> USSPACECOM's presentation was the worst briefing on space I have seen. The content was totally inappropriate for the audience and the briefer was obviously unprepared.[9]

> The program of instruction for space support did a great disservice to the military space community. The USSPACECOM brief was exceptionally poor. The curriculum completely missed the mark. It should focus on two things: How space-based assets can support the warfighter and how he can get the products he needs quickly. It is a waste of time to discuss the differences between Molniya and Geosynchronous orbits. The students do not care and will forget what you have told them in five minutes. Just tell them that COMSAT's and DSP satellites remain fixed over a point on the ground, so they are available 24 hours/day. Similarly, let them know that photorecon satellites will be able to image a point on the earth twice a day. Let them know that we cannot "hover" or reposition satellites easily. BOTTOM LINE: Talk about capabilities and products. Leave technical limitations out unless students ask about them.[10]

This academic year saw an improvement. Although with a 75 percent or higher as a weakness gauge and 35 percent or higher a strength, there is still a lack of space knowledge with CGSC graduates. This data will be more relevant when we review these areas with respect to what the space experts say students should know along with what graduates in the units say students need to know.

Results of CGSC Directors Questionnaire on Space-Related Curriculum

The Directors questionnaire showed that most directorates do not incorporate any space curriculum, systems benefits, or space products into their courses. The Directorates of the Combat Studies Institute (CSI), the Department of Sustainment and Resourcing Operations (DSRO), the Leadership Instruction Department (LID), the U.S. Navy Section, and the U.S. Marine Corps Section have not, and did not plan at this time to, incorporate space into their core or elective courses. The other departments, the Center for Army Tactics (CTAC) and the U.S. Air Force

Element, have a very limited space curriculum. The exception is the Department of Joint and Combined Operations (DJCO) which teaches the 83 hour Space Operations elective.

This is significant because these directorates have 14 core courses and 87 electives offered from their departments. This adds up to 521 out of 524 core hours that space will not be mentioned. It also equates to 82 out of 87 electives' courses or 94.3 percent of the electives that will not include space in its instruction.

Senior Army Officers Vision on Space Instruction for CGSC Graduates

Lieutenant General Lionetti's credentials as Commander, U.S. Army Space and Strategic Defense Command, demonstrate a wealth of experience in air defense, space, and education. This unique background was significant in gaining General Lionetti's insights on what a field grade officer attending CGSC should know about space. In general terms, each CGSC officer should have a basic knowledge of how space can support any operation in which their unit is involved. This knowledge should include space systems capabilities and their application. The areas of communications; position/navigation; reconnaissance, surveillance, and target acquisition; environmental monitoring (weather and terrain); tactical warning; and strategic defenses were identified as areas which should be covered.[11]

As a general rule, the students should all be aware of what systems are currently available, what is going to divisions and corps and what they can expect to see already in divisions and corps.[12] Very few officers need to become experts in any of the functional areas of space support and the A552 elective, Space Operations, is designed specifically for those officers.

An initial starting point for understanding current and future space systems capabilities is the Commercial Space Package (CSP) which the Chief of Staff, U.S. Army has approved. This

package, which is maintained by Army Space Command, can be used to support corps and division exercises and real-world contingencies. Some of the key components of this package are:

1. Communications. Commercial INMARSAT communications terminal which allows secure voice, data and fax. In the near future will be able to transmit digital camera images as well. This is a point-to-point circuit system that is used for communications with the early entry forces.

2. Weather. High Resolution Weather Receiver provides both civil weather and Defense Meteorological Support Program weather to a corps in a reduced size. The current MARK IV van, composed of a 38 foot truck and trailer, will be replaced with a processor/receiver that will fit in the back of a HUMMV.

3. Multispectral Imagery. Using digital satellite imagery, processors in corps and division can build digital maps of areas covered by LANDSAT and SPOT satellites. These multispectral imagery processors can do digital image mapping and terrain analysis.

4. Mission Rehearsal. Using a small, fast computer, corps and division staff members can develop a three-dimensional view of the battlefield. This will allow soldiers to practice mission planning rehearsal over unfamiliar terrain prior to operations.

Some of the space-related equipment that is on the horizon that students should be aware of are:

1. As mentioned earlier, an imagery transmission system will allow transmission of digital images over INMARSAT terminals anywhere in the world.

2. The Space Enhanced Command and Control System is a computer-based command and control base which will be used to provide space command and control products to the commander.

3. The Aviation SATCOM is a small device on a helicopter which provides two-way data communication between the aircraft and the ground station.

The above systems allow students to understand the current and future capabilities that a corps and division will have available to them. With an appreciation for these space capabilities should also come the knowledge of how to get this support for their units. Army Space Command's formation of the Contingency Space Package allows for one point of contact to be called for contingencies and exercises: the Operations Directorate of Army Space Command is where CSP is located.

Colonel James Kulbacki's in-depth knowledge of support functions for Army Space Command and his recognized expertise in communication systems contributes to his importance in this study. Colonel Kulbacki's remarks are similar to General Lionetti's in that there is a strong need for graduates to understand how to access space and what current and future products these warfighters will have access to.

> Space products are becoming more vital to the warfighter and really will provide him/her a significant combat multiplier. Over the next few years it is essential that skilled/knowledgeable space smart folks reside at all echelons of command - not experts, but more than just a touch of space and/or general knowledge.[13]

The importance of space in future operations requires the Army to make their future leaders and staff officers knowledgeable in these systems and their integration into operations. These folks must be able to 'intelligently' impact the development of plans, CONOPS, etc. that allow space products and applications to be applied at the critical time and place."[14] Providing CGSC students this knowledge will increase that integration and allow for development of warfighting plans.

Colonel Kulbacki recommends that CGSC students, as a minimum, receive a reading assignment that covers some history, but quickly gets to the "meat"--those applications that are available and their capabilities. Updated based upon technology advances. Also, the mechanism to obtain and integrate these applications should be covered.[15] Ideally, it would be more beneficial

if, as part of the core curriculum, a block of instruction could be included to provide demonstrations and hands-on opportunities. This block of instruction would apply to all branches.[16]

Colonel Kulbacki believes "the Army needs knowledgeable leaders at all levels who are space literate to apply the leverage (space) to ensure the battle is won."[17]

Results of the CGSC Graduates Questionnaire on the Actual Space Knowledge Required to Accomplish Their Military Mission

This last questionnaire is the critical link between what the lesson authors think should be taught, the students perception of what they need, the space experts beliefs on what knowledge a graduate should have and the actual space systems knowledge, products and accessibility that a mission ready soldier in a unit requires to accomplish his/her mission. The last questionnaire was distributed to graduates in January 1995. This lapse from the end of the school year till the graduates received the survey 6 months into their operational assignment allowed a true test of what knowledge of space systems/products was retained. The questionnaire was distributed to 106 graduates (10 percent) of the 1993 to 1994 school year. I received 80 out of 106 questionnaires back for a 75.5 percent return rate. A total of 7 questionnaires were returned by the postal service undelivered. These graduates were not at the units they told the class director's office they were going to. The remaining 19 questionnaires were not returned by the graduates. The number of graduates with a space background was very small, only 4 out of 80 for 5 percent. Only 1 graduate was working in a space assignment.

The graduates provided a good analysis of what graduates retain, what is important in their operational assignments, and their perspective of what CGSC should be teaching students. As I describe the results of this survey, you will see that for some questions the graduates marked more than 1 system or product to a specific question.

Looking at the areas where the graduates were strong in I could see that they were able to retain knowledge in the broad concepts of how systems work. The areas that were identified as strengths were:

1. The graduates had their greatest knowledge in how the position/navigation systems work. A strong 62.5 percent understood how the Global Positioning System worked. This area was consistently the strongest area in all the surveys.

2. The purpose for what multi-spectral imagery satellites are used for was the next strongest area. Although a complicated concept, 61.25 percent were able to correctly describe the process and purpose.

3. The next area, how our national space systems support military missions, received a strong 56.25 percent retention.

4. The area of Theater Missile Defense was the next area showing retention with 38.75 percent knowing the mission of this program.

5. The last strength identified was the understanding of the importance of communication satellites with 38.75 percent of graduates knowing the system.

Areas that were identified as weaknesses for the graduates were:

1. Even though this individual came and spoke to the students during the school year only one graduate knew who the Commander of the Army Space and Strategic Defense Command. I would have to say Lieutenant General Lionetti did not make a lasting impression on these graduates. The flip side of this is the graduates do not need to know/retain the name of the individual if they know what USASSDC can provide.

2. The next two issues were tied for second with over 9 out of 10 graduates not knowing the correct answers. The lack of knowledge of the last communication satellite placed in orbit that will provide extremely high frequency, jam-resistant, survivable strategic and tactical

communications were demonstrated by 91.25 percent of the graduates. This is a concern because the MILSTAR system is the future satellite communication system for the Army. This is even more surprising when you see 46.25 percent say that if they went to war they would utilize satellite communication systems. The second area where 91.25 percent of returns showed no knowledge was understanding the satellite system the U.S. uses for missile warning.

3. Not being able to identify one of the weather/environmental satellites was expressed by 83.75 percent of the graduates.

4. Once again the lack of understanding of who in the Army runs the Army Technical Exploitation of National Capability office was evident. Despite the fact that 35 percent said they would utilize intelligence systems or products if they went to war, 77.5 percent did not know who runs the TENCAP office.

5. The MILSTAR communication system was again the focus of the high-capacity, jam-resistant, super high-frequency for worldwide long haul communications. A few more graduates identified this correctly but still 75 percent did not know the correct answer.

6. Again a guest speaker from U.S. Space Command provided this data in a briefing. Although most knew that the Army Space Command was a subunified command of U.S. Space Command, 71 percent did not know the other two subunified commands.

7. The last area identified was the lack of understanding of how our military missions and satellite systems are integrated. For this question 68 percent could not explain the integration between the two.

The data on the strengths and weaknesses of space knowledge did not really differ from the previous student questionnaires. See Table 4 for complete results. What did change was their viewpoint. They now see a need for space knowledge and specific types of data.

TABLE 4

Results of Questionnaire from Graduates

	"NO"		"YES"	
Question	Number	Percent	Number	Percent
Do you have any space experience?	76	95%	4	5%
Do you use space systems or products in your current duty position?	52	65%	28	35%
If you went to war would you utilize space systems or products?	13	16.25%	67	83.75%
Identify the six main categories of space systems?	40	50%	40	50%
Which Army organization runs the Army Technical Exploitation of National Capability (TENCAP) office?	77	96.25%	3	3.75%
What type satellite is placed in orbit more than any other?	49	61.25%	31	38.75%
Identify one of the weather/environmental satellites.	73	91.25%	7	8.75%
What subunified commands make up the unified, U.S. Space Command?	57	71.25%	23	28.75%
Which communication system provides high-capacity, jam-resistant, super high-frequency for worldwide long haul communications?	73	91.25%	7	8.75%
Describe how a position/navigation system works?	30	37.5%	50	62.5%
Which satellite system does the U.S. use for missile warning?	74	92.5%	6	7.5%
Multispectral imagery satellites are used for what purpose?	31	38.75%	49	61.25%
Name the last communications satellite placed in orbit that will provide extremely high frequency, jam resistant, survivable strategic and tactical communications?	76	95%	4	5%
Which position/navigation system was first used by the U.S. Navy?	80	100%	0	0%

TABLE 4 Continued

Results of Questionnaire from Graduates

Question	"NO" Number	Incorrect Percent	"YES" Number	Correct Percent
Who is the Commander of the Army Space and Strategic Defense Command?	79	98.75%	1	1.25%
What is Theater Missile Defense?	49	61.25%	31	38.75%
Does the United States have an Active/Deployable anti-satellite program/weapon?	34	42.50%	46	57.50%
How are military missions and satellite systems integrated?	72	90%	8	10%
How do our national space systems support military missions?	35	43.75%	45	56.25%
In your current duty position, to whom would you go if your commander told you he needed some Global Positioning System (GPS) receivers?	46	57.50%	34	42.50%
In your current duty position, to whom would you go if your commander told you he needed to get access to a communication satellite frequency for access to CENTCOM's AOR?	28	35%	52	65%
In your current duty position, to whom would you go if your commander told you he needed to see a satellite photo of Korea?	26	32.50%	54	67.50%
In your current position will you ever have a need to use space systems or products?	37	46.25%	43	53.75%
Do you think you will ever have a need to know about space systems or products in any future assignment?	18	22.50%	62	77.50%
Do you have the reference material distributed during the space lessons in C510 at CGSC?	17	21.25%	63	78.75%
Do you have any additional comments about the space curriculum you received at CGSC?	58	72.50%	22	27.50%

1. Thirty-five percent of the graduates use space systems or products in their current duty position. The most used systems were navigation, followed by intelligence and then satellite communications.

2. When asked if they think they will ever need to use space systems or products in their current duty position, 54 percent believed they would. Most identified communication as the most likely system followed by intelligence and navigation.

3. When required to go to war, 83.75 percent would utilize space systems or products. Most would use communication systems followed by navigation systems and then intelligence products. A number of graduates also identified imagery as a requirement for them at war time.

The last category of questions shows the type data graduates require in order to accomplish their missions. They did not identify a need to know what each system is and how they operate but how does a soldier identify the required product and who/where does he go to in order to have access to a system or product.

1. If a unit needed some Global Positioning System (GPS) receivers, 42.5 percent of graduates knew where to go in order to get these receivers.

2. In the situation where you needed to get access to a communication satellite frequency, a total of 65 percent of the graduates knew who to go to in order to obtain the frequency.

3. When asked to obtain some satellite photos, 67.5 percent of the graduates knew who to go to in order to obtain the imagery.

These three questions are the key to what graduates actually use in their units. They need to know who to contact in order to receive space products or access space systems. A good number of graduates said they utilized the handouts from the CGSC space lesson to identify the Point of Contact (POC) to access space products and systems.

The last question shows the need to ensure CGSC students are taught about space systems and products. A total of 77.5 percent of the graduates believe they will need to know about space systems and products in future assignment positions.

CHAPTER 6

CONCLUSION

With the United State's focus of space on strategic nuclear users, the U.S. Army had a very small group of personnel involved with space. As we saw in DESERT STORM and since, the use and distribution of space systems and products involve every soldier, sailor, airman, and marine.

> The contributions of space forces to U.S. defense strategy and military operations were not widely recognized prior to the Persian Gulf conflict of 1991. In part, this was because DOD's exploitation of space systems during the Cold War focused heavily on providing support to the National Command Authorities and strategic nuclear users in peacetime. [1]

We now realize the significant role's space systems played "in the success of contingency operations in Grenada (Urgent Fury, 1983), Libya (El Dorado Canyon, 1986), the Persian Gulf (Earnest Will, 1988), and Panama (Just Cause, 1989)."[2]

Every Army officer should know the capabilities that space provides him/her on the battlefield and how to capitalize on these systems. The only way to ensure these officers are aware of these systems, their capabilities and products, and how to obtain this data is to educate officers at every level of development.

This thesis was an unclassified evaluation of how well and how thoroughly the Army incorporated space into its officer development program.

In discussing the curriculum with the DJCO course and lesson authors, it was apparent that CGSC does not do a good job of conducting any needs' assessments to determine the proper type, length, or depth of subjects taught in a course. As an adult educator, who has degrees in

curriculum, instruction, and adult and continuing education, I believe it is imperative that a formal need's assessment be conducted prior to development of a course. This assessment assists in determining the required curriculum, knowledge, and material a student needs.

The authors in DJCO are responding to too many outside requirements' verses conducting a formal documented need's assessment to determine what a corps, division, or brigade commander/staff believe is the right area of focus. Artificial restraints are also limiting the amount and type of training presented to the students. Over the last few years, there has been a very heavy focus on limiting the number of hours of instruction, laboratory time (practical exercise), and even homework readings. We have become more concerned about appeasing the students and less concerned about demanding the students learn all they can in this year of schooling.

This study is the first one I am aware of by a former instructor to see how to improve a course of instruction and, thus, the CGSC curriculum. Over the last several years, the changes to curriculum were based on student ACCESS reports and their comments. Also, each new instructor changes his lesson or course to add in his knowledge base. A good example of this is lesson 12, C520. From the completion of trainup in December 1993 to our final presentation to division B, I received several different additional instructor methodologies along with daily author personal inputs.

Along with looking at our curriculum development, I reviewed the curriculum of the other Intermediate Service Schools (ISS). The Air Force presents a considerably more in-depth space curriculum then CGSC. At first glance, one could ask why CGSC does not have such a program. In reality, the Air Force has such a program because they have the vast majority of space personnel and activities. Air Force personnel develop, operate, manage, and control space assets for DOD. The average Army officer does not need to be exposed to space launch control and space support

activities. What the Army officer needs to understand is the systems used in force enhancement and how they can contribute to his/her warfighting skills.

You can not compare the type and volume of space curriculum among the ISS students because each service has a unique role to play in space. What we can utilize from the other ISS's is how and in what format to teach pertinent space subjects to their students. The Navy has a format very similar to that of the Army, focusing on readings and discussions. We both do this in a very short block of instruction. The Air Force has really propelled itself to the forefront of space instruction by integrating space throughout their curriculum. They use demonstrations, distribution of products, and short discussion points to tie the relevance of space to their entire aerospace doctrine.

CGSC should look to integrate space curriculum into the other core and elective courses by incorporating products (imagery of areas being utilized to develop a plan, weather photos to discuss METT-T, environmental photos to locate the best logistical routes) into the curriculum. Demonstrations of space systems and products can help visualize and reinforce short discussions during CTAC, DSRO and DJCO courses. Space history could be incorporated into the CSI lessons to help integrate it into Army history as well.

The student questionnaire was the first critical portion of this study. The students were able to quantify what they did and did not learn from their 3-hour lesson on space. They were able to identify which functions of space operations they were able to understand through the readings, discussions, or the practical exercise. They were also able to identify which areas we had not been able to convey to them. This type of data is very relevant when we compare it with what the space command experts believe is necessary for CGSC graduates to understand about space. More importantly, it is relevant to what former students believe is the necessary depth and level of space understanding required by graduates in the field.

The questionnaire provided a good picture of what students and graduates were able to retain. They also provided some insight into what is needed by the soldiers and also what is not needed. To attempt to make a soldier aware of each system and how they operate is not practical. The lessons should be refocused to introducing the soldiers to the key space systems that soldiers will utilize in the field and more importantly who and how to get access to the products and capabilities of these systems. Having a good guest speaker is also an important aspect that should be addressed. A dynamic speaker can generate interest and questions while a poor speaker only causes students to be turned off to the topic. The space instructors should help focus the subject and content of the speaker's presentation to stimulate the students and also to coincide with the DJCO instruction periods.

Interviewing the departments to see which core or elective courses contained any space curriculum, products, or system capabilities only confirmed what I already suspected. Each Directorate is busy concentrating on their prescribed agenda and CGSC does not do a good job of integrating subject matter across directorates. When you have 524 hours of core courses and only 3 hours are utilized to present a subject, that reinforces your image. The intent is not to increase the number of hours allocated to "space" but to integrate products and capabilities into the other courses.

For the electives there are over 2500 hours among 87 courses yet there is only a very limited use of space outside the 83 hour space elective presented by DJCO.

The next component of this study was the discussion/questionnaire with General Lionetti and Colonel Kulbacki. Capitalizing on these individuals' expertise and key positions in Army space we can see what type and how much space knowledge a CGSC graduate requires. These senior officers were candid and direct describing what type knowledge is required and how that knowledge can be provided. They did not demand that space be a vital part of every course but

they did present the means to increase the student's awareness of space benefits without a dramatic increase in lesson hours.

The last component and really the key to understanding the appropriate level of space curriculum that student's need comes from the questionnaire given to former graduates who could provide first hand knowledge of what types, amount and in what format of space knowledge do they need. These soldiers responded from an operational perspective as to what type of space related knowledge they required to accomplish their duties. The bottom line is that they needed a cursory level of the systems and what they could provide as well as an understanding of the space products available to help them do their mission. The key was to be able to go to the experts in the systems and get them to provide the products required. The soldier himself did not need to be an expert in space system and did not need an in-depth understanding of how they worked only that they were available for his/her use.

As we review the collected data from Chapter 5 and review the conclusions from this chapter, I have answered the most important questions from this thesis, the primary research question: Does the Army Command and General Staff College student receive an appropriate level of space-related curriculum? This question had us look at the amount of time, resources, and personnel that are applied to teaching space curriculum at CGSC and see if it is appropriate.

The data provides us with some clear weaknesses from the student's viewpoint. Students do not know how to access or obtain space system products. They do not have an adequate understanding of the roles and missions of the space organizations which is required by the Joint Professional Military Education. They do not have a good understanding of the force enhancement systems which is what CGSC's space curriculum focuses on.

Looking at what the space experts believe students should know upon graduation there is a correlation between the lack of available time, resources, and what students need to know. To have

a good understanding of current and future systems, products, and knowing how to access and obtain these products CGSC needs to devote more time and resources to space curriculum.

Our review of the other ISS space curriculum shows that we can integrate these capabilities and products by using and incorporating other ISS curriculum and GEO Dynamics material throughout our curriculum. This includes both the core and elective courses.

CGSC must also trainup all CGSC instructors through the Officer Professional Development (OPD) program and the instructor trainup period to make sure they are cognizant of space capabilities and use these assets during the planning, support and combat phases of an operation.

Value of the Study

This study was critical in the assessment of how the amount of time, resources, and personnel assigned to a particular lesson are developed and implemented. In similar fashion, CGSC should analyze all of its courses to ensure the appropriate course material is being developed, taught, and focused on developing the soldier's full warfighting capability.

This study was important to address how the core authors distribute lesson hours. The students' comments are valid for the particular lesson they received but not to changing the lessons after each division. A set concept/objectives should be develop based on a thorough evaluation of soldiers needs in the field. From those objectives a course should be built and evaluated by follow instructors. Then the lesson taught to the students. CGSC should then be careful how they respond to students critiques. Students are good at evaluating how the lesson was presented but often do not have the insight into what is important for them to learn and what is not important.

Space operation at CGSC is important. It is this exposure at CGSC that prepares these future Brigade and Battalion commanders to fight the next DESERT STORM, Haiti, and Bosnia.

Space systems and products will be key during each of these operations so it is critical that theses' students get the right exposure to space and understand what space system provides them. An integrated curriculum would help reinforce this knowledge throughout the year and allow more to be retained as these soldiers go off to combat assignments.

CHAPTER 7

RECOMMENDATIONS

The Army's CGSC is the last school most of these students will attend. Thus, CGSC needs to ensure they are teaching the appropriate material and to the correct depth. As the force-multiplying effects of space technology increases, Army commanders and staff officers must understand how space assets can support and enhance future military operations. Below I have identified some recommendations that when implemented, I believe will ensure the CGSC graduate has the appropriate level of space knowledge.

This study was designed to determine if CGSC presents an appropriate level of space instruction at CGSC. I believe I have met that tasking by the thorough analysis of the students, space experts' and graduate responses to the questionnaires. I have reviewed what the other ISS teach and determined that the Air Force's in-depth space curriculum would not be appropriate for CGSC. What would be appropriate is to integrate space systems, products and capabilities throughout the core and elective curriculum to reinforce the importance of space and to help students retain this information. Having Army Space Command and other space organizations bring demonstrations and products to CGSC to enable the students to have hands on interface with these systems would also help reinforce their capabilities.

The inclusion of the other ISS curriculum and Directorates comments verify what they were or were not teaching in their courses. This information allowed me to understand what type of space knowledge a student needs as he departs for his next assignment.

I believe to improve the space curriculum at CGSC the following recommendations will have to be incorporated into the appropriate lessons and courses.

The Command and General Staff School should conduct an in-depth review of the courses offered at CGSC. This review should focus on whether the courses being presented are relevant and appropriate for field grade officers. This review should be conducted by an independent group not associated with any department to ensure biases are eliminated. Commanders, staff agencies and key corps, division and brigade staff members should be interviewed to help determine the proper type, depth, and length of course material.

Conducting a true need's assessment by independent, outside personnel will help ensure that what is needed by the future leaders of the Army is actually being presented to them. The selection of an unbiased party, possible the Space Division, Army Training and Doctrine Command, Fort Monroe, who can document the proper level of space curriculum will be hard to do. Each agency involved in space activities will naturally slant toward their systems, products, or agenda. I do not believe, from my past experience with contractors, that a commercial firm should be selected for this assessment. We want to ensure that the curriculum selected is the best possible for these students and not flavored with personal compensation.

For the upcoming school year, I believe an in-depth pre- and post-questionnaire should be given to students to determine if our space curriculum is successfully conveying the appropriate level of space knowledge to students. This step will require the space instructors in DJCO to work with Dr. Lowden, Standardization and Evaluation Office. Develop a comprehensive pre-test to determine the students' knowledge of critical space systems and access procedures. This test will be developed using Army Space Command and previous CGSC students' recommendations for what CGSC students should know about space upon graduation.

After a year long integrated space curriculum then a post-test should be administered to rate how well the material was presented and how well students understood the key systems, products, organizations, and how to access them for exercises and real-world contingencies.

As mentioned earlier, the Air Command and Staff College (ACSC) at Maxwell AFB, Alabama, has developed a very integrated space curriculum with the assistance of GEO Dynamics Corporation. Mr. Richard Brynes, a member of their staff is available to work with the DJCO space instructors to see what products, demonstrations and courseware are available for CGSC use. This curriculum can be integrated throughout CGSC similar to ACSC without an increase in lesson hours. Capitalizing on the other ISS developed curriculum can save time and expense in improving these lessons.

To assist in developing this working relationship between the service schools the CGSC space instructors should go and visit Maxwell AFB. They should discuss, observe, and facilitate how ACSC presents their space curriculum and utilizes this data to improve CGSC's curriculum. This is important because over the last six years CGSC has received course material but has not visited and discussed course development with their ISS counterparts.

The space instructors should attend all Post Instructional Conferences (PIC) and speak with each core and elective course author to see how, where, and in what format space can assist their course or lesson. This integration of space into all departments can only occur with the cooperation of each Director.

CGSC should continue to invite for discussion the Commander, U.S. Army Space and Strategic Defense Command. As the Army's premier advocate of space, he can keep CGSC on the cutting edge of development in systems, products and doctrine. Others who should be close associates are the U.S. Army Space Command and their Space Demonstration Program and also the members of Space Division, Army Training and Doctrine Command. These organizations

should be invited and a closer working relationship should be developed between staff personnel and the CGSC instructors.

The space demonstration program, as both General Lionetti and Colonel Kulbacki suggested, should be an integral part of the CGSC curriculum. This program has to take into consideration the students' diverse schedule and be committed to spending several days/a week at CGSC. A classroom should be set up with the demonstration equipment and each section (60 students) should be scheduled for a two hour hands-on demonstration of all the current and future systems the Army has at their disposal. By allowing for a week at Fort Leavenworth, each section can get a chance to thoroughly see and understand this equipment.

Lastly, the elective's program should be reviewed to see which courses can include space integrated into them. With only 5 of 87 courses currently including space, a number of courses are candidates for integration. CSI could include more about the Army's role in space. DSRO could incorporate space products like LANDSAT or SPOT environmental satellite photos to discuss the best logistical routes for an operation. DJCO can utilize the different communications capabilities during the Operations Other Than War (OOTW) lessons and show how important communications are to these operations. CTAC can utilize multi-spectral imagery during their development of Courses of Action to help with METT-T. These are only a few areas that can be incorporated easily. The 87 electives' courses could also utilize the same type of space systems and products to reinforce the courses in the second half of the year.

A product that could be utilized by all would be a directory that would identify who in the Army is the Point of Contact for each major space system and product. This way graduates of CGSC could have a quick reference document to help them locate and contact the necessary personnel to obtain the required access or product.

It is imperative for those who are writing doctrine, directing training, and executing operational plans to understand fully how the Army relies on space assets. The Army needs to be concerned with the foundation on which these CGSC officers will make critical decisions and will execute the doctrine.

I believe that CGSC does not have to change the "hours" allocated to space lessons but needs to integrate space throughout the curriculum like the Air Force ACSC does. I do not believe CGSC has to invest in greater resources but to incorporate the capabilities of Army Space Command and the Space Demonstration Program into the curriculum. I believe that CGSC does not have to invest addition time for extra space lesson if they utilize the courses already available throughout the curriculum to reinforce space knowledge at Fort Leavenworth.

ENDNOTES

Chapter 1

[1]. CGSC Circular 351-1, U.S. Army Command and General Staff College Catalog, Fort Leavenworth, KS, July 1992, 32.

[2]. U.S. Army Command and General Staff College Catalog, 32.

[3]. U.S. Army Command and General Staff College Catalog, 48.

[4]. CGSC C510 Syllabus, Joint and Combined Environments, Fort Leavenworth, KS, 1 August 1992, 35.

[5]. Joint and Combined Environments, 35.

[6]. Army Space Institute, Space Support to the Army, Fort Leavenworth, KS, 1992, slide #27.

Chapter 3

[1]. Downey, Arthur J., The Emerging Role of the U.S. Army in Space, Washington, D.C.: National Defense Press, 1985, 1.

[2]. Beard, Edmund, Developing the ICBM: A Study in Bureaucratic Politics, 1976, 22.

[3]. Downey, 2.

[4]. Stares, Paul B., The Militarization of Space: U.S. Policy, 1945-1984, New York: Cornell University Press, 1985, 23.

[5]. Stares, 23.

[6]. Downey, 2.

[7]. Beard, 142.

[8]. U.S. Congress, House, Committee on Government Operations, Organization and Management of Missile Programs, 86th Congress, 1st Session, 1959, 128.

[9]. Schichtle, Case, The National Space Program: From the Fifties into the Eighties, 1983, 45.

[10]. Medaris, John B. Major General, Countdown for Decision, 1960, 67.

[11]. Medaris, 122.

[12]. Medaris, 147.

[13]. Schichtle, 46.

[14]. Schichtle, 48-49.

[15]. Schichtle, 47-48.

[16]. Schichtle, 53.

[17]. Eisenhower, Dwight D., The White House Years: Waging Peace, 1956-1961, 1965, 257.

[18]. Eisenhower, 284.

[19]. Medaris, 267.

[20]. Belair, Felix Jr., "Eisenhower Acts to Strip the Army of its Space Role," New York Times, 22 October 1959, Section 1, 1, column 4.

[21]. Army Space Institute, Space Reference Text, Fort Leavenworth, KS, 1993.

[22]. Army Space Institute, Space Support to the Army, Fort Leavenworth, KS, 1992, slide #27.

[23]. Space Support to the Army, slide #27.

[24]. Space Support to the Army, slide #27.

[25]. Space Support to the Army, slide #27.

Chapter 5

[1]. CGSC C510 Syllabus, Joint and Combined Environments, Fort Leavenworth, KS.

[2]. Joint and Combined Environments,

[3]. CM-1618-93, Military Education Policy Document, Chairman, Joint Chiefs of Staff, Washington, D.C., 23 March 1993, A-A-2.

[4]. Academic Year 1992 to 1993 Student Questionnaire.

[5]. Academic Year 1992 to 1993 Student Questionnaire.

[6]. Academic Year 1992 to 1993 Student Questionnaire.

[7]. Academic Year 1992 to 1993 Student Questionnaire.

[8]. Academic Year 1993 to 1994 Student Questionnaire.

[9]. Academic Year 1993 to 1994 Student Questionnaire.

[10]. Academic Year 1993 to 1994 Student Questionnaire.

[11]. Interview with Lieutenant General Donald M. Lionetti, Commander, U.S. Army Space and Strategic Defense Command, April 1994.

[12]. Interview with Lieutenant General Lionetti.

[13]. Questionnaire comments from Colonel James W. Kulbacki, Deputy Commander for Support, U.S. Army Space Command, April 1994.

[14]. Questionnaire comments from Colonel Kulbacki.

[15]. Questionnaire comments from Colonel Kulbacki.

[16]. Questionnaire comments from Colonel Kulbacki.

[17]. Questionnaire comments from Colonel Kulbacki.

Chapter 6

[1]. Ludvigsen, Eric C., "Space Pays Off for the Field Army," Army, Volume 40, July 1990, 20.

[2]. Ludvigsen, 18.

GLOSSARY

Aerospace. Of, or pertaining to, earth's envelope of atmosphere and the space above it; two separate entities considered as a single realm for activity in launching, guidance, and control of vehicles that will travel in both entities.

Air-launched ballistic missile. A ballistic missile launched from an airborne vehicle.

Antisatellite weapon. A system used to attack a satellite with the intention of disrupting, degrading, or destroying its operation. It can be either ground or space based, and may use kinetic, electronic, or directed energy.

Ballistic missile. Any missile which does not rely upon aerodynamic surfaces to produce lift and consequently follows a ballistic trajectory when thrust is terminated.

Ballistic missile defense. The application of capabilities resulting in the negation of effects of attacking missiles.

Ballistic missile early warning system. An electronic system for providing detection and early warning of attack by enemy intercontinental ballistic missiles.

Communications intelligence (COMINT). Technical and intelligence information derived from foreign communications by other than the intended recipients.

Communications satellite. An orbiting vehicle, which relays signals between communications stations. An active communications satellite receives, regenerates, and recriminates signals between stations. A passive communications satellite reflects communications signals between stations.

Directed-energy weapon. A system using directed-energy primarily as a direct means to damage or destroy enemy equipment, facilities, and personnel.

Electronic intelligence (ELINT). Technical and intelligence information derived from foreign non-communications electromagnetic radiation's emanating from other than nuclear detonations or radioactive sources.

Electro-optical intelligence (ELECTRO OPTINT). Intelligence information other than signal's intelligence derived from the optical monitoring of the electromagnetic spectrum from ultraviolet (0.01 micrometers) through far infrared (1,000 micrometers).

Force application operations. Consist of combat operations conducted from space with the objectives of strategic defense and power projection.

Force enhancement operations. Those space-related support operations conducted to improve the effectiveness of terrestrial and space based forces. Force enhancement includes capabilities as communications, navigation, and surveillance.

Foreign instrumentation signals intelligence (FISINT). Technical information and intelligence information derived from the intercept of foreign instrumentation signals by other than the intended recipients. Foreign instrumentation signal's intelligence is a category of signal intelligence. Foreign instrumentation signals include but are not limited to signals from telemetry, beaconry, electronic interrogators, tracking/fusing/arming/firing command systems, and video data links.

Human resources intelligence (HUMINT). The intelligence information derived from the intelligence collection discipline that uses human beings as both sources and collectors, and where the human being is the primary collection instrument.

Imagery intelligence (IMINT). Intelligence information derived from the exploitation of collection by visual photography, infrared sensors, lasers, electro-optics and radar sensors such as synthetic aperture radar wherein images of objects are reproduced optically or electronically on film, electronic display devices or other media.

Infrared intelligence. That imagery produced as a result of sensing electromagnetic radiation's emitted or reflected from a given target surface in the infrared position of the electromagnetic spectrum (approximately 0.72 to 1,000 microns).

Intermediate-level college. A formal, intermediate-level Service college or equivalent; includes institutions commonly referred to as Intermediate Service Colleges, Intermediate-Level Schools, Intermediate Service Schools, or Military Education Level-4 producers.

Joint professional military education. Joint Professional Military Education (JPME) addresses the integrated employment of land, sea, and air forces at all levels of war.

Joint school or course. A school or course used by two or more Services that has a joint faculty and a director (commandant) assigned from the Services on a rotational basis who is responsible, under the direction of the Joint Chiefs of Staff, for the development and administration of the curriculum.

Kinetic energy weapon. A weapon that uses a nonexplosive projectile moving at very high speed to destroy a target on impact. The projectile may include homing sensors and on-board rockets to improve its accuracy, or it may follow a preset trajectory (as with a shell launched from a gun).

Military education. The systematic instruction of individuals in subjects which will enhance their knowledge of the science and art of war.

Military space operations. Actions and activities performed using space systems to accomplish, or support the accomplishment of, military objectives. They include actions and activities intended to achieve control of space and application of JCS-designated DOD space systems in response to requirements levied by the Joint Chiefs of Staff.

National security space sector. Those governmental space activities which are necessary to national defense.

National space policy. National commitment to the exploration and use of space in support of the well being of the nation.

Professional military education (PME). Provides individuals with the skills, knowledge, understanding, and appreciation that enable them to make sound decisions in progressively more demanding command and staff positions within the national security environment. PME has as its primary theme the employment of combat forces, with strategy being increasingly emphasized at the intermediate, senior, and general/flag officer levels. It addresses the military, political, economic, social, and psychological dimensions of national security with varying degrees of emphasis on the planning and conduct of war, service organizations, joint and combined operations, force employment and deployment concepts, and military leadership.

Program for joint education (PJE). Program is a JCS-approved body of principles and conditions that prescribes, at both the intermediate and senior levels of professional military education, the joint curriculums, student-faculty mixes and ratios, seminar-service mixes, standards, and learning objectives for all educational programs designed to qualify officers for Joint Staff Officer (JSO) designation. National War College and Industrial College of the Air Force curricula encompass the entire PJE. Other educational institutions approved by CJCS conduct PJE phase I and Armed Forces Staff College conducts PJE phase II. Officers who complete both PJE phase I and phase II satisfy the educational requirements for JSO qualification.

PJE phase I. That portion of the PJE that is incorporated into the curricula of intermediate and senior-level Service colleges and other appropriate educational programs, which meet PJE criteria and are accredited by the Chairman of the Joint Chiefs of Staff.

Reconnaissance. A mission undertaken to obtain, by visual observation or other detection methods, information about the activities and resources of an enemy or potential enemy; or to secure data concerning the meteorological, hydrographic, or geographic characteristics of a particular area.

Satellite and missile surveillance. The systematic observation of aerospace for the purpose of detecting, tracking, and characterizing objects, events, and phenomena associated with satellites and in-flight missiles.

Signal's intelligence (SIGINT). A category of intelligence information comprising either individually or in combination all communications intelligence, electronics intelligence, and foreign instrumentation signal's intelligence, however transmitted.

Space. The environmental medium above the earth's atmosphere, distinct from the earth's atmosphere. There is no generally accepted definition for where air ends and space begins. Administratively, space begins at an altitude of 44 nautical miles above the earth's surface.

Space control operations. Operations that provide freedom of action in space for friendly forces while, when directed, denying it to an enemy, and include the broad aspects of protection of U.S. and U.S. allied space systems and negation of enemy space systems. Space control operations encompass all elements of the space defense mission.

Space defense. All defensive measures designed to destroy attacking enemy vehicles (including missiles) while in space, or to nullify or reduce the effectiveness of such attacks.

Space forces. The personnel, systems, and organizational structure required to conduct military space operations.

Space launch. The process and systems to place a spacecraft into space.

Space power. The ability of a nation to exploit the space environment in pursuit of national goals and purposes. It involves utilization of all elements of the nation's space infrastructure.

Space support operations. Operations required to ensure that space control and support of terrestrial forces are maintained. They include activities such as launching and deploying space vehicles, maintaining and sustaining space vehicles while on orbit, and recovering space vehicles if required.

Space system. A system designed for the express purpose of operating in the medium of space. Typically, a space system is composed of three segments: a ground control segment; the spacecraft itself, including the launch vehicle; and the communications control segment which provides the link between the spacecraft and the using or controlling ground stations.

Strategic intelligence. Intelligence which is required for the formation of policy and military plans at national and international levels.

Surveillance. The systematic observation of aerospace, surface or subsurface areas, places, persons, or things, by visual, aural, electronic, photographic, or other means.

Tactical intelligence. Intelligence which is required for the planning and conduct of tactical operations.

Telemetry intelligence. Technical information and intelligence information derived from the intercept, processing, and analysis of foreign telemetry. Telemetry intelligence is a category of foreign instrumentation signal's intelligence.

BIBLIOGRAPHY

Army Space Institute. Space Support to the Army. Fort Leavenworth, KS, 1992. Slide # 27.

Beard, Edmund. Developing the ICBM: A Study in Bureaucratic Politics. 1976.

Belair, Felix Jr. "Eisenhower Acts to Strip the Army of its Space Role," New York Times. 22 October 1959, Section 1, column 4.

Briggs, Bruce. "The Army in Space: New High Ground or Hot-Air Balloon?" Military Review. (December 1986), 44-49.

Canan, James W. "Space Gets Down to Earth." Air Force Magazine. 73 (August 1990): 30-35.

Carlucci, Frank C. "DOD's Space Policy: An Overview." Defense 88. (November/December 1988): 2-6.

CGSC Circular 351-1, U.S. Army Command and General Staff College Catalog. Fort Leavenworth, KS, July 1992.

CGSC C510 Syllabus, Joint and Combined Environments. Fort Leavenworth, KS, 1 August 1992.

Collins, John M. Military Space Forces: The Next 50 Years. New York: Pergamon-Brassey's, 1989.

Downey, Arthur J. The Emerging Role of the U.S. Army in Space. Washington D.C.: National Defense University Press, 1985.

Eisenhower, Dwight D. The White House Years: Waging Peace, 1956-1961. 1965.

Fuller, Thomas. "DOD in Space: A Historical Perspective." Defense 88. (November/December 1988): 26-31.

Gerhardt, Igor D. "Space and the AirLand Battle," Army. 40 (June 1990): 43-48.

Harris, Elwyn, Richard Darilek, Kenneth Horn, and Mark Nelson. The Army's Role in Space: Support for the Battlefield Commander. Santa Monica CA: Rand Corporation, July 1988.

Herres, Robert T. "Space-Based Support." Defense 88. (November/December 1988): 7-12.

Hudson, Heather E. Communication Satellites: Their Development and Impact. New York: Free Press, 1990.

Kirby, Stephen and Gordon Robson, ed. The Militarization of Space. Boulder, Colorado: Lynne Rienner Publishers, INC., 1987.

Lake, Julian S. "Space Systems in Tactical Battle Management." Defense Science 88 (October 1988): 19-22.

Ludvigsen, Eric C. "Space Pays Off for the Field Army." Army 40 (July 1990): 18-24.

Lunan, Duncan. "Fighting for High Ground." Defense and Foreign Affairs. 17 (March 1989): 8-12.

Medaris, John B. Major General. Countdown for Decision. 1960.

Piotrowski, John L. "Space Operations Tomorrow: Emphasizing the Tactical. Defense. 88 (November/December 1988): 20-25.

Robblee, Paul A. Jr. The Army's Stake in Emerging Space Technologies." Parameters. 18 (December 1988): 113-119.

Roe, L. MAJ, and Wise, D. MAJ. "Space Power is Land Power: The Army Role in Space." Military Review. January 1986.

Schichtle, Case. The National Space Program; From the Fifties into the Eighties. 1983.

Sendak, Theodore T. Army Role in Space: Design of an Army Corps Incorporating Space Capabilities. Carlisle Barracks: U.S. Army War College, May 1986.

Stares, Paul B. The Militarization of Space: U.S. Policy, 1945-1984. New York: Cornell University Press, 1985.

U.S. Army Space Agency. Commander's Handbook of Space Systems for Support of Army Forces. Peterson AFB, Colorado, March 1987.

U.S. Congress, House, Committee on Government Operations. Organization and Management of Missile Programs. 86th Congress, 1st Session, 1959.

Whelan, C. Richard. Guide to Military Space Programs. Arlington VA: Pasha Publications, Inc., 1986.

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